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CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

Method of Calculating Excavation and Embankment. By GEORGE A. SIMONSON, *Polytechnic College of Pa.*

The shortest way of making these calculations is by the aid of diagrams invented by Mr. J. C. Trautwine, Civil Engineer. But as the engineer is sometimes required to estimate earth-work, when these diagrams are not in his possession, and as the shortest rule at present employed which will give accurate results, is the prismoidal formula, which is certainly very tedious, it is expedient that a shorter equation for the solidity be prepared.

After finding the end areas, according to the usual rule, *i. e.*, multiply the extreme horizontal width by half the centre cutting, and add the product to $\frac{1}{4}$ the width of the roadway into the sum of the outside cuttings; we can find an expression for the solidity in terms of these areas, the width of the roadway and the slope of the bank. The following equation, original with me, I believe to be as simple as any. Denote the greater area by A, and the lesser by *a;* Express the length of the embankment or excavation by L, the depth of the greater cut by C, and that of the lesser by *c*. C, and *c*, are the cuttings of level cross-sections having the same areas, respectively, A and *a*, as the sections under consideration. Denote the horizontal width, or the distance between the two slope stakes of a level excavation whose depth is equal to C, by W, and the horizontal width corresponding to *c* by *w*. Let R equal the width of roadway, and *s* the

horizontal distance for a unit of height in the slope, and, finally, let s stand for the solidity; then the expression deduced for s is

$$s=\frac{L}{3}\left(2a+A+\frac{A-a}{\sqrt{\frac{4\,A\,s+R^2}{4\,a\,s+R^2}}+1}\right)$$

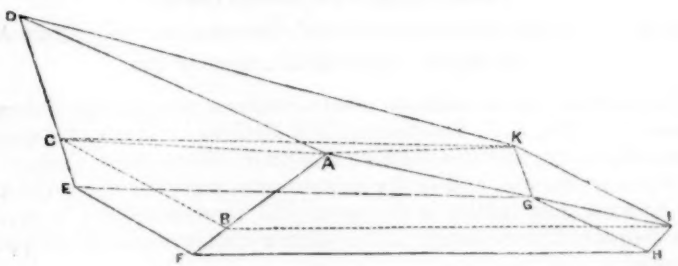
The expression by the prismoidal formula is

$$s=\frac{L}{6}\left(A+a+4\left(\frac{3}{2}\left(\frac{\sqrt{\frac{2A}{3}+\left(\frac{R}{3}\right)^2}-\frac{R}{3}+\sqrt{\frac{2a}{3}+\left(\frac{R}{3}\right)^2}-\frac{R}{3}}{2}\right)+R\right)\times\left(\frac{\sqrt{\frac{2A}{3}+\left(\frac{R}{3}\right)^2}+\sqrt{\frac{2a}{3}+\left(\frac{R}{3}\right)^2}-\frac{2R}{3}}{2}\right)\right)$$

when the slope is $1\frac{1}{2}$ to 1, or that most generally used, and for any slope.

$$s=\frac{L}{6}\left(A+a+4\left(s\,\frac{\sqrt{\frac{A}{s}+\left(\frac{R}{2s}\right)^2}+\sqrt{\frac{a}{s}+\left(\frac{R}{2s}\right)^2}-\frac{R}{s}}{2}+R\right)\times\left(\frac{\sqrt{\frac{A}{s}+\left(\frac{R}{2s}\right)^2}+\sqrt{\frac{a}{s}+\left(\frac{R}{2s}\right)^2}-\frac{R}{s}}{2}\right)\right)$$

It will be seen that the first equation is much shorter than the prismoidal formula. Let us now consider its demonstration.



Let A D E F represent the cross-section of a level cutting C, equal A, and G H I K G that of a cutting *c* equal *a*. The solidity in practice is considered equal to that of a regular prismoid whose end areas and length are equal to any irregular one under consideration. This, however, is not strictly true, because the surface of the ground excavated will usually be more or less warped. When very much warped, intermediate cross-sections between two stations, must be taken. Under the supposition that the irregular solid is equivalent to the regular prismoid in the figure, let us find its solidity.

Make F B=H I and C E=G K, join B and C, B and I, and C and K. The solidity of the prism thus formed of which each of the end areas equals *a*, and the length of which is the length of the whole solid equals $a\times L$. Draw

A C and A K forming the rectangular pyramid whose vertex is at A, and whose base is B C K I $=w\times$L. Now the altitude of this pyramid is $c-c$, hence its solidity $=w\times \text{L}\frac{c-c}{3}$. There remains the triangular pyramid whose base is A C D and whose altitude is the length of the prismoid, because its vertex is at K. Its solidity $=\frac{\text{W}\times(c-c)}{2}\times\frac{\text{L}}{3}$. But the prismoid is made up of the prism and the two pyramids, hence we may write for its solidity,

$$s=a\,\text{L}+\frac{w\,\text{L}\,(c-c)}{3}+\frac{\text{W}\times(c-c)\text{L}}{6}$$ or as L is a common factor,

$$s=\text{L}\left(a+\left(w+\frac{\text{W}}{2}\right)\left(\frac{c-c}{3}\right)\right)$$ or by bringing w and W to a common denominator $s=\text{L}\left(a+\frac{2w+\text{W}}{2}\,\frac{c-c}{3}\right)=\text{L}\left(a+\frac{2\,c\,w+c\,\text{W}-2\,c\,w-c\,\text{W}}{6}\right)$

But $\text{A}-a=\text{A B C D}=\frac{\text{W}+w}{2}\,(c-c)$ or $2\,\text{A}-2\,a=c\,w+c\,\text{W}-c\,w-c\,\text{W}$; now, by adding $c\,w-c\,w$ to each side of this equation, there results, $2\,\text{A}-2\,a+c\,w-c\,w=2\,c\,w+c\,\text{W}-2\,c\,w-c\,\text{W}$; substituting this value in the last equation for the solidity, and bringing a into the numerator, we obtain $s=\text{L}\left(\frac{4\,a+2\,\text{A}+c\,w-c\,w}{6}\right)$ but

$\frac{\text{W}+w}{2}\,(c-c)=\text{A}-a$, or $c-c=\frac{2\,\text{A}-2\,a}{\text{W}+w}$. By multiplying both members of the last equation by w we get $c\,w-c\,w=\frac{w}{\text{W}+w}(2\,\text{A}-2\,a)$; substituting this value in the last equation for the solidity, we obtain

$s=\frac{\text{L}}{3}\left(2\,a+\text{A}+\frac{w}{\text{W}+w}(\text{A}-a)\right)$ or $s=\frac{\text{L}}{3}\left(2\,a+\text{A}+\frac{\text{A}-a}{\frac{\text{W}}{w}+1}\right)$.

Let us now find a value for the widths in terms of the areas, slope, and roadway. We have first $\frac{\text{W}+\text{R}}{2}c=\text{A}$ because A D E F is a trapezoid. But $c=\frac{\text{W}-\text{R}}{2s}$; therefore $\frac{\text{W}^2-\text{R}^2}{4s}=\text{A}$, or $\text{W}=\sqrt{4\,\text{A}\,s+\text{R}^2}$; in like manner we should find $w=\sqrt{4\,a\,s+\text{R}^2}$, and substituting these values in the last formula for the solidity, we obtain

$$s=\frac{\text{L}}{3}\left(2\,a+\text{A}+\frac{\text{A}-a}{\sqrt{\frac{4\,\text{A}\,s+\text{R}^2}{4\,a\,s+\text{R}^2}}+1}\right)$$ as previously given.

This formula will apply to embankmen's, because an embankment presents the same figure as an inverted excavation.

Example. In the first cross-section, let the centre cut be 3 feet, the right cut 2 feet, and the left cut 5 feet. In the second, let the centre cut be 2 feet, the right cut 1 foot, and the left cut 4 feet. Required the solidity when the width of the roadway is 20 feet, the slopes $1\frac{1}{2}$ to 1, and the distance between the sections 100 feet.

$$\text{Here } A=(1\tfrac{1}{2}\times 5+1\tfrac{1}{2}\times 2+20)\times 1{\cdot}5+(5+2)\frac{20}{4}\Big)=80{\cdot}75,$$

$$a=(1\tfrac{1}{2}\times 4+1\tfrac{1}{2}\times 1+20)\times 1{\cdot}5(4+1)=52{\cdot}5, \text{ and}$$

$$s=\frac{100}{3}\left(2\times 52{\cdot}5+80{\cdot}75+\frac{80{\cdot}75-52{\cdot}5}{\sqrt{4\times 80.75\times 1\tfrac{1}{2}+20^2}-4\times 52{\cdot}5\times 1\tfrac{1}{2}+20^2}+1\right)$$

$$s=\frac{100}{3}\left(185{\cdot}75+\frac{28{\cdot}25}{\sqrt{1{\cdot}237063+}}\right)=\frac{100}{3}\left(185{\cdot}75+\frac{28{\cdot}25}{2{\cdot}1122}\right)=\frac{19912{\cdot}5}{3}=$$

6637·5 cubic feet = 245·8 cubic yards.

By the prismoidal formula we find from the areas a cutting of an equivalent level cross-section by the formula $c=\sqrt{\frac{A}{s}+\left(\frac{R}{2s}\right)^2}-\frac{R}{2s}$ or

$c=\sqrt{\frac{80{\cdot}75}{1\frac{1}{2}}+\left(\frac{20}{3}\right)^2}\Big)-\frac{20}{3}=3{\cdot}24686$ and $c=\sqrt{\frac{52{\cdot}5}{1\frac{1}{2}}+\left(\frac{20}{3}\right)^2}-\frac{20}{3}=$ 2·24654, and $\frac{3{\cdot}24686+2{\cdot}24654}{2}=2{\cdot}7467$, the middle cut. For the area corresponding to this cut we have $\left(\frac{2{\cdot}7467\times 3}{2}+20\right)2{\cdot}7467=66{\cdot}2504$, and by the prismoidal formula we have

$$s=\frac{100}{6}(4\times 66{\cdot}2504+80{\cdot}75+52{\cdot}5)=6637{\cdot}5 \text{ cu. feet}=245{\cdot}8 \text{ cu. yards.}$$

For the Journal of the Franklin Institute.

Panama Railroad.

We gather from a recent official report on this work, that its entire length is 47 miles and 3020 feet. The maximum grade is 60 feet to a mile, descending from the summit towards the Pacific; on the descent from the summit towards the Atlantic, the maximum is $58\frac{9}{10}$ feet to a mile. $23\frac{3}{5}$ miles are level and $28\frac{3}{5}$ miles are straight. It is a single track road, laid partly with a bridge or ∩ rail of 58 pounds per yard; and partly with a T rail of 56 pounds. The gauge is not stated. Its cost, including rolling stock, land, depots, &c., will be about seven and a half millions of dollars, or about $158,000 per mile.

AMERICAN PATENTS.

List of American Patents which issued from November 20th, to December 18th, 1855, (inclusive,) with Exemplifications.

NOVEMBER 20.

70. For *Improvements in Knitting Machines;* Timothy Bailey, Ballston Spa, N. Y.

Claim.—"1st, Actuating the sinking or other burrs, by means of a gear wheel, whose teeth are actuated, or rather acted upon, by the needles as a rack, whereby the wings in said burrs are freed from contact with the needles, and do not nip the yarn tightly between said wings and the needles, substantially in the manner and for the purpose described. 2d, Carrying back the old stitch and holding it back, by means of a disk wheel and segment, having a planetary motion, as herein set forth; and also the leading of the finished cloth, through a ring or its equivalent, surrounding a shaft having a planetary motion, whereby the action of the drag weights is properly adjusted upon different portions of that circuit of the cloth which is being acted upon by the needles and levers, substantially as herein specified, and in combination with a cloth or knitted tube, to which is imparted substantially such a revolving motion as is herein described. 3d, A self-adjusting climbing drag weight, constructed substantially in the manner herein set forth. 4th, A stationary series of needles in circuit, when constructed and arranged substantially in the manner described, in combination with revolving levers, driven by independent gearing, and traveling from needle to needle, whereby the turning of the finished cloth on its own axis is avoided, and all difficulties incident thereto obviated."

71. For an *Improvement in Mop Heads;* Alexander Burns, Ashtabula, Ohio.

Claim.—"What I claim as new and my invention, and for which I desire to secure letters patent, is attaching the screw to the cross piece and riveting it in such a manner that its revolution is not obstructed, combined with the bow and nut as described, for the purpose specified."

72. For an *Improvement in Cutting Teeth of Gear Wheels;* G. W. Bigelow, New Haven, Connecticut.

Claim.—"Giving the blank or wheel to be cut, an automatic feed motion, by means of the pulley on the shaft, said pulley having a coil spring within it, the screw on the shaft, the worm wheel on the lower ends of the shaft, and the circular plate, having projections upon its periphery, and the pawl and bar provided with the arm, the cam being operated by the pins on the inner side of the pulley; the above parts being arranged substantially as shown and described."

73. For an *Improvement in Locks;* J. H. A. Bleckmann, Ronsdorf, Prussia.

Claim.—"The mode of constructing and arranging one, or a number of tumblers as described, which may be locked and opened with changeable key bits."

74. For an *Improvement in Cotton Gins;* Lewis S. Chichester, City of New York.

Claim.—"Giving to one or both of the rollers of a roller gin, the separating motion, to separate the rollers for discharging the seed, after the fibres have been separated. Also, the guard and discharge plates, in combination with the two rollers of a roller gin, having a separating motion. Also, the clearing and collecting brush, in combination with the ginning rollers."

75. For an *Improvement in Double Acting Pumps;* D. W. Clark, Bridgeport, Conn.

Claim.—"Giving to the two reciprocating pistons when arranged, to move in the one cylinder, by intermediate gear, a simultaneous travel in the same direction, at about the period of change of stroke in the pistons, while for the remainder, or the greater part of their stroke, they travel in opposite directions, to effect the required double action specified, of the two pistons in the one cylinder, and whereby the one piston serves to follow up the movement of the other, in their joint action upon the one body of water between the pistons, till a fair hold is got upon the water to render the suction continuous, neutralize the effect of leakage, and prevent the formation of an air or vacuous space, between the two pistons, at their turning stroke, and run apart from the water between them, by means of the revolving eccentrics or their equivalents, pitched or set with "lead" in relation to each other, and the two pistons of the single cylinder."

76. For *Ticket Holders;* Edward Pierre Fraissinet and Henri Emile Reboul, Paris, France.

Claim.—"The construction of an apparatus or instrument for carrying, securing, and exhibiting tickets."

77. For an *Improved Machine for Printing Yarns and Cloths;* Thomas Henderson, Lowell, Massachusetts.

Claim.—"1st, The printing or coloring types. 2d, The coloring distributors, and boxes in which they revolve. 3d, The types, in combination with jacquard operation, for printing and coloring figured goods. 4th, The types, in combination with the color distributors and boxes."

78. For an *Improvement in Treating Leather for Enamelling;* Theodore P. Howel and Noah F. Blanchard, Newark, N. J.

Claim.—"The combination of the cylinder with the elastic slotted bags, for softening tanned and dry leather for japaning purposes."

79. For an *Improvement in Hand Seed Planters;* D. W. Hughes, New London, Mo.

Claim.—"The seed box and perforated slide, when attached to the blades connected by a joint."

80. For an *Improved Method of Attaching Tops to Seats of Carriages;* Lyman Jacobs and E. C. Landon, Castile, New York.

Claim.—"The method of concealing the back rails of seats to carriages, by means of grooves in the back of the tops. Also, in combination with the grooves, the mode of fastening tops to seats of carriages, by means of beveled nuts and bolts."

81. For an *Improvement in Potato Digger;* Aaron A. Marcellus, City of New York.

Claim.—"In combination with the revolving rakes, the undulating surfaced separator and receiver."

82. For *Policemen's Rattles;* Joseph McCord, Philadelphia, Pennsylvania.

Claim.—"The securing of the handle to the edge of the ratchet wheel, and at right angles to the axis of the latter, for the purpose of turning down the handle out of the way, thereby rendering the instrument more convenient to carry in the pocket, and for the further purpose of combining a mace and rattle in one instrument."

83. For an *Improvement in Railroad Station Indicators;* Charles A. McEvoy, Richmond, Va.

Claim.—"Presenting a movable sign or symbol, to passengers of a railroad car, so that both sides of said sign shall be visible and utilized as communicators, by swinging said signs to the angles of a polygonal reel, in such manner as to make each sign in turn drop through a slot."

84. For an *Improvement in Gun Locks;* John Phin, Rochester, New York.

Claim—"Securing accuracy of aim and safety in the use of trigger-cocking fire arms by means which consist, first, in the sear and spring to hold the hammer up, and, secondly, in the spring acting on the trigger, to release said hammer."

85. For an *Improvement in Cotton Presses;* William F. and Charles J. Provost, Selma, Alabama.

Claim.—"1st, The manner of hanging and holding the platen, by means of the rod and the coupling link, so that the platen may be swung around out of the way and the rod let down. 2d, A combination with the levers and their fulcras, the pivoting of the long one of said levers, to one side of the centre of the follower to cant, and to apply the power of the press in as near a direct line to the resistance as possible."

86. For an *Improved Machine for Preparing Leather, for the Manufacture of Boots and Shoes;* Charles Rice, Boston, Mass., and Sylvanus H. Whorf, Roxbury, Massachusetts.

Claim.—"1st, The retracting guard, in combination with the spring and rod, when constructed, arranged, and operating from the raker's seat. 2d, The grain guard."

87. For an *Improved Marble Sawing Machine;* F. Noette and A. Schmidt, Brooklyn, New York.

Claim.—"The combination and arrangement of the described devices, when the same are all arranged and operated in the precise manner described, and not otherwise."

88. For an *Improved Street Sweeping Machine;* M. W. St. John and Isaac Brown, Leonardsville, New York.

Claim.—"1st, The reciprocating brooms or brushes, attached to a bar which is connected with the pitmans. 2d. The endless apron placed underneath the machine, for the purpose of receiving the dirt from the brooms or brushes, and carrying it from underneath the machine and depositing it in winrows in the street. 3d, The combination of the endless apron and reciprocating brooms or brushes. 4th, Connecting the swivel wheel with the back end of the draft pole by a lever. 5th, Placing the driving wheels and pinions loosely on their respective shafts, and operating the ratchets by means of the flanched sliding plate, for the purpose of throwing the working parts of the machine in and out of gear with the driving wheels."

89. For an *Improvement in Coal Sifters;* Gerard Sickels, Brooklyn, New York.

Claim.—"The peculiar manner of dividing the cylinder, for the purpose of furnishing a receptacle for the separated coal."

90. For an *Improved Method of Inserting Tubes in Evaporating Pans, &c.;* George H. Thomas, Kingston, Mass.

Claim.—"The method of securing tubes to tube sheets, by making the tubes without projections on the surface, that they may be inserted directly through holes in the tube sheets, in combination with clamps at the ends of the tubes and overlapping the joints."

91. For an *Improvement in Revolving Measuring Wheels;* Louis Young, City of New York.

Claim.—"The arrangement of the box containing the count wheel, in connexion with the stock carrying the measuring wheel, in such manner that said box is made to serve as a convenient handle for working the instrument."

92. For an *Improvement in Nutmeg Graters;* Hirem Carsley, Assignor to self and Edmund Brown, Lynn, Mass.

Claim.—"The combination of the box and holder, and the pressure spring, or contrivance with the rasping surface of the grater."

93. For an *Improvement in Lifting Jacks;* Francis Drew, Assignor to self and Solomon S. Gray, South Boston, Mass.

Claim.—"The jack, consisting of the sockets, with their connecting arms and pawls, in combination with the ratchet wheels and cog wheels."

94. For an *Improved Filtering Faucet;* Louis Finger, Assignor to self and Lazarus Schell, Boston, Mass.

Claim.—"The brush, in combination with the plate and passages."

95. For an *Improvement in Mills for Grinding Coffee, &c.;* Cornelius W. Van Vliet, Fishkill Landing, New York, Assignor to Charles Parker, Meriden, Conn.

Claim.—"The peculiar arrangement of the crushing and grinding cones, and in combination therewith, the passage leading from the largest circumference of the upper cone to the smallest circumference of the lower cone."

96. For *Improved Envelopes;* Emanuel Harmon, Washington, D. C.

Claim.—"The manufacture or preparation of envelopes with parallel lines on the interior of the back."

97. For an *Improvement in Mills for Grinding Apples;* W. O. Hickok, Harrisburg, Pennsylvania.

Claim.—"The breakers, whether used in combination with the helical ribs and the tube, so as to produce a separate and distinct depression around each tooth, or whether the said breakers are used in combination with the teeth above."

NOVEMBER 27.

98. For a *Balance for Detecting Spurious Coin;* John Allender, New London, Conn.

Claim.—"A single lever of such a size and weight, and provided with cavities or counter sinks, arranged at such distances each side of the fulcrum, as to weigh the smaller coins upon the lightest arm without additional weight, and the larger coins, two or more, on the heaviest arm with one weight in one position on the lighter arm."

99. For an *Improvement in Blacksmiths' Striker;* Dennis S. Blue, Fort Seneca, O.

Claim.—"The use of slotted lever treadle, the slotted lever, and the rock shaft."

100. For an *Improvement in Steam Heating Apparatus;* Pliny E. Chase, Philadelphia, Pennsylvania.

Claim.—"The peculiar arrangement of the pipes, the draft pipes, and the tanks, in combination with the steam chamber."

101. For an *Improvement in Belt Coupling;* Thomas H. Corbett, Brooklyn, N. Y.

Claim.—"Coupling the two ends of a belt or any two objects together by means of two clamps and a double wedge key."

102. For an *Improvement in Fences;* H. H. Dennis, Steam Mill, Pennsylvania.

Claim.—"The mode of connecting the rail and post by mortise with convex top and bottom groove."

103. For an *Improvement in Drilling and Screw Cutting Machines;* Joel P. Heacock, Marlborough, Ohio.

Claim.—"The use of pulleys and set ring, operating conjointly on the feather."

104. For an *Improvement in Coopers' Tool;* Joel P. Heacock, Marlborough, Ohio.

Claim.—"The constructing of a "cooper's tool" for the purpose of over-shaving."

105. For an *Improvement in Cat-Head Anchor Stoppers;* Peter H. Jackson, City of New York.

Claim.—"The combination of the locking piece with its cam, combined with the hasp, so that said cam piece forces the hasp out of the notch, as said locking piece is turned to one side, and causes the ring or loop over the hasp to be thrown off or disconnected."

106. For an *Improvement in Bag Looms;* L. B. Jillson and George Sparhawk, Lewiston, Maine.

Claim.—"1st, Placing the two sets of studs of the pattern cylinder for weaving the sides and bottom of the bag in slides fitted to the cylinder, to slide longitudinally thereto, so as to admit of the changing of the harness motion from weaving the sides to weave the bottom of the bag, or vice versa, by shifting the whole or any number of the said slides, according to the number of picks desired in the bottom. 2d, The combination of the sliding rod, having a fork and finger, with the notched disk carrying the pinion, the pawl, or its equivalent, the worm wheel, and the endless screw on the cylinder, all operating for the purpose of shifting the slides in the cylinder to change the operation of the harness."

107. For an *Improvement in the Method of Hanging the Screens of Winnowing Machines;* John A. Krake, Alden, New York.

Claim.—"The peculiar arrangement and combination of parts, by which the action of the screens is confined, exclusively, to lateral vibratory motion."

108. For an *Improvement in the Preparation of Umbrella Sticks, &c., of Ratan;* Joseph Kleeman, Meissen, Germany.

Claim—"The preparation of ratan by impregnating it with drying oils and varnishes, for the purpose of giving it flexibility, elasticity, tension, and an appearance similar to whalebone, the ratan so prepared to be used as a substitute for whalebone in the manufacture of umbrella and parasol frames, and for other purposes for which whalebone can be employed."

109. For an *Improvement in Cannon;* Alfred Krupp, Essen, Prussia; patented in France, December 16, 1847.

Claim.—"1st, The manufacture of cannons from solid pieces of cast steel. 2d, The surrounding cannons and other parts of artillery when made of cast steel with an outer casing of cast iron, steel, or wrought iron, or gun metal."

110. For an *Improvement in the Mode of Cutting the "Uppers" of Boots;* John S. Lewis, Athol, Massachusetts.

Claim.—"Cutting the boot front all the way down no wider, or but little wider, than the usual width of the part which is to form the front of the leg and filling the vacancy which is thus caused, when the joint is crimped by a separate piece, by extending the back or counter, or by a piece produced in any other way, whereby the saving is effected in cutting the fronts."

111. For an *Improvement in Attaching Casters to Trunks;* Leonard S. Maring, Fall River, Massachusetts.

Claim.—"Constructing and arranging casters on trunks."

112. For an *Improvement in Machines for Rasping and Dressing the Heels and Soles of Boots and Shoes;* Jean Pierre Molliere, Lyons, France; patented in France, January 5, 1855.

Claim.—"The circular tools, with rasping and dressing the bottoms of heels and soles of boots and shoes."

113. For an *Improvement in Ovens for Baking Bread and other Aliments;* Jean Louis Rolland, Paris, France; patented in France, June 30, 1851.

Claim.—"The arrangement of the horizontal flues within the hot air chamber and beneath the baking floor."

114. For an *Improvement in Sewing Machines;* George W. Stedman, Vienna, N. J.

Claim.—"Feeding the cloth, or other material, along by means of the thread which is suitably acted upon, for the purpose of tightening each stitch."

115. For an *Improved Printing Press;* Cyrus A. Swett, Boston, Massachusetts.

Claim.—"Inking the blocks with their appropriate colored inks by means of the rollers. Further, the cylinder vibrating bed or plate with endless apron attached."

116. For an *Improvement in Metallic Saddle Trees for Harness;* Samuel E. Thompkins, City of New York.

Claim.—"Providing metallic harness saddle trees with an elevated bridge. And, in combination with the same, employing ribs on the front portion of the underseat."

117. For an *Improvement in Feet Warmers;* Nathaniel Waterman, Boston, Mass.

Claim.—"Placing the hot water vessel within a case made of wood, except on that side on which the feet are to rest, which side is made of thin sheet metal, and cushioned and covered, the whole being for the purpose of retaining the heat longer and giving it out more regularly to the feet."

118. For an *Improvement in Fluid Lamps;* William Bennett, Brooklyn, N. Y., Assignor to the Union India Rubber Lamp Company, City of New York.

Claim.—"The elastic bag or receptacle placed within the body of a lamp, or within a proper framing or support to receive and hold the fluid."

ADDITIONAL IMPROVEMENT.

1. For an *Improvement in Ventilating and Warming Houses;* Henry Ruttan, Coburg, Canada; original patent dated Dec. 5th, 1848; additional, Nov. 6, 1855.

Claim.—"The foul air receptacle, added to and connected with the system of ventilation, patented to me Dec. 5th, 1848, said receptacle being connected with the vertical passages and ventilating chimneys."

RE-ISSUE.

1. For an *Improvement in Harvesting Machines;* Jonathan Haines, Pekin, Illinois; patented March 27th, 1849; re-issued November 6, 1855.

Claim.—"In combination with a frame nearly balanced on its supporting wheels, and a tongue hinged to said frame, a lever connected to one, and projecting towards the driver's stand or seat on the other, so that the driver, who is the sole conductor of the machine, may, from said stand or seat, raise or depress the cutters, at pleasure, during the operation of the machine for cutting the grain or grass, at any suitable height above the ground, or for passing over any intervening obstacles, substantially as described. Also, in combination with the operative parts of a harvesting machine, a conveyor, which first carries the cut grain horizontally across the machine, and then elevates it so as to discharge the grain into the bed of a wagon driven alongside of the machine, when the conveyor frame is connected to the bed, by a flexible joint."

DESIGNS.

1. For *Coal Stoves;* Garrettson Smith and Henry Brown, Assignors to Leibrandt, McDowell & Co., Philadelphia, Pennsylvania; dated November 6, 1855.

Claim.—"The combination of ornaments, the whole forming an original design for a coal stove."

2. For *Stoves;* Benjamin Wardwell, Fall River, Massachusetts; dated Nov. 20, 1855.

Claim.—"The border on the edge of the base, the borders and other embellishments on the doors, the wreath on the rim or projection of the cylindrical portion of the stove, and the embellishments on the panels on the cylindrical portion."

3. For *Steam Tubes and Hot Air Covers;* James O. Morse, City of New York, and J. W. Adams, Lexington, Kentucky; dated November 27, 1855.

Claim.—"The scrolls and the figured ground work on the trusses, and the circular embellishment and figured fret work on the panel; also, the fret work in the frame or borders."

DECEMBER 4.

1. For an *Improvement in Suspending Ships' Yards;* Thomas Batty, Brooklyn, N. Y.

Claim.—"The arrangement of the yard, the beam, and the crane."

2. For an *Improvement in Cutting Pile Fabrics;* Erastus B. Bigelow, Boston, Mass.

Claim.—"The employment of a rotating cutter, in combination with take-up rollers."

3. For an *Improved Mode of Hanging Window Sashes;* E. W. Bullard, Hardwick, Massachusetts.

Claim.—"The improved mode of hanging and fastening sashes, which consists in beveling one side of the sash and combining therewith a corresponding wedge or beveled strip moved up and down, by which arrangement the modes of fastening, loosening, and removing the sashes from the frame are secured."

4. For an *Improvement in Military Saddles;* Daniel Campbell, Washington, D. C.

Claim.—"1st, Placing the arch of the connecting strap of the holsters below the pommel of the saddle, and supporting the holsters upon projections from the forward ends of the side bars of the saddle tree, or their equivalent. 2d, Covering the holsters, by means of the roof piece attached to the connecting strap of the holsters, and the covers which are pivoted to the sides of the holsters. Also, constructing the valise of two connected receptacles which are supported immediately in the rear of the legs of the cantel."

5. For an *Improvement in Making Plough Mold Boards;* Thomas A. Chandler, Rockford, Illinois.

Claim.—"The forming eccentric roller, clamp plate, with the lever, and the press-plate."

6. For an *Improvement in Machines for Sawing Out Tapering Blocks of Marble;* John A. Cole, Washington, D. C.

Claim.—"Attaching the saw to swinging frame by pivots at each end, which will admit the shoes turning to any angle to follow guides."

7. For an *Improved Instrument for Chamfering the Edges of Shoe Soles, &c.;* Alonzo R. Dinsmoor and Levi J. Bartlett, Salisbury, New Hampshire.

Claim.—"The combination and arrangement of the lever gauge and spring presser, with the knife blade or chisel."

8. For an *Improvement in the Arrangement of Flues and Dampers in Cooking Apparatus;* John A. Elder, Westbrook, Maine, and Wm. J. Thorn, Hollistory, Mass.

Claim.—"The arrangement of the dampers, in combination with the oven flues for regulating and controlling the heat."

9. For an *Improvement in Car Coupling;* Joseph T. England, Baltimore, Md.

Claim.—"The coupling consisting of a ball so arranged in the buffer-head, as to support, at its lowest position, the pin, and to be pushed away and allow the pin to fall on the introduction of the link."

10. For an *Improvement in Wool Combing Machines;* Peter Fairbairn, Leeds, and John Hargrave, Kirkstall, England; patented in England, November 6, 1852.

Claim.—"Combining in one and the same machine, two or more rotary gill cylinders fitted with advancing and receding gills, and rotating at different speeds."

11. For an *Improvement in Feet Warmers;* Henry Fourcrook, Elbridge, N. Y.

Claim.—"The arrangement of the angular supports upon the inner box, thereby providing the foot warmer with a hot air chamber; also, with substantial supports for the outer box."

12. For an *Improvement in Military Wagons;* Joseph Francis, City of New York.

Claim.—"1st, Constructing the bodies of road wagons and like vehicles of corrugated plate metal, supported by a bottom frame permanently attached thereto, so as to serve to support the iron body at all times, and be used as a sled upon which to drag the superstructure when taken off its wheels, and made water-tight for transportation. Also, the mode of attaching and detaching the running gear, so as not to pass any bolts which are liable to wear and cause a leak through any part of the water-tight body, but simply to connect the same with the frame by the outside connexions and braces, so as to securely brace the iron body in proper form and be permanently united therewith."

13. For an *Improvement in Bagasse Furnaces;* Samuel H. Gilman, New Orleans, La.

Claim.—"The pit located between the furnace and the boilers in a passage way. Also, the perforated blast pipes of the feed opening."

14. For an *Improved Burglars' Alarm;* Samuel Hamilton, Tolland, Massachusetts.

Claim.—"Constructing an alarm with an actuating pull knob, having a catch spring watch disk formed with a tube, together with the rail, the blocks, links, hook spring, sliding blocks, with catch devices, the secret spring strip; through all of which, in combination with clock work devices, are actuated bells or alarms."

15. For an *Improvement in the Machine for Cutting Out Boot and Shoe Soles;* Jesse W. Hatch, Rochester, New York.

Claim.—"1st, The projections at different distances on the face of the wheel and the fork on the sector lever, having its prongs at different elevations. 2d, The application of the spring friction bar to the yoke for preventing the return of the sector lever before the proper time."

16. For an *Improved Burglars' Alarm;* Horace L. Hervey, Quincy, Illinois.

Claim.—"The combination and arrangement of levers, springs, stop levers, slotted levers, key levers, flat sided levers, connecting levers, and links, varying the alarm at pleasure by means of the stop levers and for drawing the bolt."

17. For an *Improvement in Hand Cotton Pickers;* George A. Howe, Worcester, Mass.

Claim.—"The endless belt or chain of gatherers, stripper, bag, and case."

18. For *Improvements in Cutting the Fronts and Backs of Violins;* Matthias Keller, Philadelphia, Pennsylvania.

Claim.—"1st, The slides with the pattern, lever, and spindle with its cutter, for the purpose of forming any number of exactly similar backs and fronts of violins from one pattern. 2d, The supplementary lever with its connexions, in combination with the levers and slot, for the purpose of forming the concave sides of backs and fronts of violins, without changing the pattern used for forming the convex sides, and for the purpose of giving the said backs and fronts a gradual and correct tapering thickness."

19. For an *Improvement in Amalgamators;* Edward N. Kent, City of New York.

Claim.—"The employment of double action paddle wheels, which rotate on their own axis, and revolve about a vertical axis, within, and in combination with a column of water in a vessel having the discharge at or near the top. Also, sustaining the paddle wheels in the column of water from above, and causing them to rotate on their own axis by the weight of the heavy pan resting on the peripheries above, that mercury may be employed in combination therewith at the bottom and below the wheels."

20. For an *Improvement in Locks,* Edward Kershaw, Boston, Massachusetts.

Claim.—"In connexion with a rotating lock bolt, or its equivalent, the combination of the shank and segmental tumblers with the tubular recess of the lock case enclosing the same, with their several subordinate appendages co-operating with each other."

21. For an *Improvement in Pumps;* Hosea Lindsey, Ashville, North Carolina.

Claim.—"The horizontal cylinder and pipe connected, the cylinder being provided with valves and piston rods, being operated as the pipe and cylinder rotate by the curved flanch."

22. For an *Improvement in Spoke Machines;* Thomas R. Markillie, Winchester, Ill.

Claim.—"The arrangement of the cam on the pattern, in combination with the tracer and a spring. Also, the particular arrangement of the rotary cutter and tracer, in combination with the plate that supports them suspended."

23. For an *Improvement in Machines for Scouring Knives;* G. M. Morris and J. Newton, Watertown, Connecticut.

Claim.—"The machine for scouring knives, the same consisting of two scouring rollers and a trough for containing the cleansing material, said rollers being arranged over each other above the trough, and each of them formed of a series of woolen or other absorbent elastic disks, arranged on a screw shaft and forced and confined compactly together by two movable metallic disks."

24. For an *Improvement in Locks;* J. H. Pomeroy, Bloomington, Illinois.

Claim.—"The use of the spring bolt or catch, or its equivalent, so constructed as to be operated by the door frame or keeper to release the bolt and fasten the door."

25. For an *Improved Photographic Bath;* Isaac Rehn, Philadelphia, Pennsylvania.

Claim.—"The overflowing bath with the conducting trough and receiving chamber, or their equivalent."

26. For an *Improvement in Boot Trees;* James H. Sampson, Grafton, Massachusetts.

Claim.—"The combination and arrangement of the three levers and the screw applied to the two sections of the tree and made to operate together. Also, the combination of the spring lever catch with the foot and front section."

27. For a *Self-Regulating Hot Blast for Furnaces;* Charles Schinz, Camden, N. J.

Claim.—"The use of the pipe and the bar, operating conjointly by means of suitable gearing upon the eccentrics for opening and closing the valves, so as to divide a given volume of air of varying temperature and pressure into proportionate parts."

28. For an *Improvement in Cloth Stretching Rollers;* Nathan Simmons, Providence, Rhode Island.

Claim.—"The improvement in the cloth stretching roller or cylinder, consisting in imparting to its sectional stretchers while the roller is in revolution, consecutive movements in one direction or away from the middle of the roller."

29. For an *Improved Means of Connexion between Regulator Valve and Governor Stem;* John Tremper, Philadelphia, Pennsylvania.

Claim.—"Effecting the connexion between the throttle valve cut-off, or other regulator valve and the governor stem, by means of a pin working within a slot or against a bearing face, the said slot or bearing face having an escape opening, opposite to which, the pin is brought by the cessation of the operation of the governor, whereby the pin is allowed to escape from the said slot or bearing face, and thereby effect the disconnexion of the governor from the valve or cut-off, instantaneously, to allow the valve to be closed by a spring or weight, provided for the purpose, to stop the engine immediately after the governor ceases to operate, the said pin being attached to the governor rod, and the said slot or bearing face and escape opening being in or upon the lever of the throttle valve or cut-off, or what is equivalent, the pin being attached to the said lever and the slot or bearing face and escape openings being in the connecting rod of the governor or in a plate connected therewith, or what is equivalent, a toothed rack and segment."

30. For an *Improved Blind Fastener;* Daniel E. True, Lake Village, New Hampshire.

Claim.—"The arrangement of the spring bolt at the extremity of the outer lever, and connecting said lever with the blind, so as to be self-fastening, and withdrawn by the same lever movement operating the blind."

31. For an *Improvement in Machines for Paring and Slicing Apples;* Levi Van Hoesen, New Haven, Connecticut.

Claim.—"The combination of a spring with a slicing machine when constructed with an arrangement whereby the fork carrying the apple may be turned so as alternately to be brought into play with the paring knife and with the slicing wheel, being at the same time thrown into gear in the former case, and out of gear with the latter."

32. For an *Improvement in Quartz Crushing Machines;* Richard Vose, City of N. Y.

Claim.—"Supporting the centre of the inclined vessel upon a semi-spherical hub, which works in a raised perforated socket in the plate, whilst the depressed portion of the periphery of said vessel is supported upon a horizontal plane or track, by which I am enabled to impart the requisite movements to the said vessel through the medium of a shaft descending from a hub, and in connexion with the said method of supporting and operating the inclined vessel. Also, discharging the contents of the said vessel through an aperture in the descending operating shaft. Also, in connexion with the peculiar manner of supporting and operating the vessel, the combining of the periphery of said vessel with the supporting frame by means of the springs, or their equivalents, for the purpose of steadying the movements of said vessel and preventing it from turning upon its axis."

33. For an *Improvement in Hand Sowers;* Moses D. Wells, Morgantown, Virginia.

Claim.—"Effecting the seed discharge and regulating the amount of the same by means of the double inclined planes of bar reciprocating without the hopper."

34. For an *Improvement in Machines for Preparing Cotton Seed for Planting;* R. C. Wrenn, Covington, Kentucky.

Claim.—"Pads, in combination with cylinder and teeth, in combination with hopper slide."

35. For an *Improvement in Water Wheels;* John H. Gatiss, Franklindale, Pa., Assignor to Abraham Edwards, Towanda, Pennsylvania.

Claim.—"The arrangement of the gates, passages, and buckets of a centre vent wheel, so that the water may act upon each bucket simultaneously and with equal force, first striking them at their very lowest points, and held thereto by the lips or flanches, and then escaping to the centre discharge."

36. For an *Improved Machine for Channeling Stone;* John Taggert, Roxbury, Mass., Assignor to self and Vernon Brown, Boston, Massachusetts.

Claim.—"Supporting the operative machinery of the drill saws by means of standards extending down therefrom and resting upon the bottom of the grooves made with stone by said drills, the same enabling said operative parts or machinery to move downward with the drill in proportion as they may cut into the stone."

37. For a *Gimlet;* Chester C. Tolman, Assignor to James Sargent and Daniel P. Foster, Shelburne Falls, Massachusetts.

Claim.—"Constructing the lower or outer of the two screw threads or flanches of the gimlet in rounded or curved parabolic form, and having the sides of said portions of the threads or flanches brought to a sharp or cutting edge, the screw or worm being used or not, as desired."

38. For an *Improvement in Machinery for Opening and Feeding Cotton to the Gin;* Major B. Clarke, Newnan, Georgia.

Claim.—"The arrangement of the toothed feeding roller, the adjustable gate, and the adjustable comb with each other."

DECEMBER 11.

39. For an *Improved Application of Embossed Leather;* Israel Amies, Philadelphia, Pennsylvania.

Claim.—"The employment of embossed veneers in the construction of furniture, and for other ornamental purposes."

40. For an *Improvement in Machinery for Folding and Measuring Cloth;* James Baxendale, Providence, Rhode Island.

Claim.—"1st, The employment of separate rods for the several folds of the cloth, the said rods being arranged and operated to fall across the successive layers of the cloth, as they are laid, by the movements of a suitable reciprocating carriage over the folding table, and to remain within the folds till the folding of the whole piece is completed. 2d, The manner of operating the said rods to throw them from their upright positions across and upon the cloth by means of the nut and the screws, which are actuated by the movements of the reciprocating carriage."

41. For an *Improvement in Boot and Shoe Peg Cutters;* Henry E. Chapman, Albany, New York.

Claim.—"The making of shoemakers' floats or peg cutters with planing cutters."

42. For an *Improved Fountain Ink Stand;* Charles T. Close, City of New York.

Claim.—"The arrangement and combination of the upper tube or passage connecting the top or air space of the reservoir with the pen cup at or immediately below the level the ink is designed to stand in said cup, the latter being connected with the reservoir and the ink in the pen cup, forming a fluid valve that, upon the insertion of the pen and withdrawal thereof, alternatly opens and closes the lower end of the upper connecting tube for the free, rapid, and certain admission of fresh air at intervals in the reservoir, as required."

43. For an *Improvement in Water Gauges for Steam Boilers;* Josephus Echols, Columbus, Georgia.

Claim.—"Making gauge tubes for indicating the height of water in steam boilers, with an aperture provided with convex glass, presenting the convex or arched surface to the pressure in the tube."

44. For an *Improvement in Gas Apparatus;* John S. Gallaher, Jr., and John W. Smith, Washington, D. C.

Claim.—"Solely, the arrangement of the parts, and specifically, of the retort, with Hooks's blow-pipe combined with the furnace, the water reservoir, the strainer, the receiver, for the purpose of constituting a compact and portable gas generating and purifying apparatus."

45. For an *Improvement in Railroad Car Springs;* P. G. Gardiner, City of New York.

Claim.—"My improved car sping is composed of a coiled plate spring, combined with a segmental brace and a movable segmental cap."

46. For an *Improvement in Tile Roofing;* Gottlieb Graessle, Hamilton, Ohio.

Claim.—"The construction of tile roofing, having each overlapping edge resting by an angle only upon the flat sublying surface between the ridges of the adjacent tile, and having two transverse ridges on the top of each tile, enclosed by similar ridges projecting from the superjacent surfaces of the tier next above."

47. For an *Improvement in Buckles;* Sheldon S. Hartshorn, Orange, Connecticut.

Claim.—"Constructing the tongue and loop of the buckle in one part and at one operation, in such a manner, that the socket will firmly secure the joint in the other part, so as to need no other fastening."

48. For an *Improvement in Machines for Raking and Loading Hay;* John K. Harris, Allensville, Indiana.

Claim.—"The pitcher or elevator, in combination with the rake, for the purpose of taking the hay from the rake in regular successive intervals of time and in separate parcels, and elevating and delivering it on the wagon."

49. For an *Improvement in Bedsteads;* Benjamin Hinkley, Troy, New York.

Claim.—"The cross bars, whether springs or not, for the support of a bedstead frame, when the same are mounted on a pedestal and stand."

50. For an *Improvement in the Mode of Attaching Extinguishers to Lamps;* F. A. Jewett, Abington, Massachusetts.

Claim.—"Attaching the cap or extinguisher to the lamp by means of a spiral spring coiled around the wick tube, and secured at one end to the cap and at the other to the screw plate or any other convenient locality, whereby the cup is tightly drawn down over the wick."

51. For an *Improvement in Locks for Freight Cars;* Henry C. Jones, Newark, N. J.

Claim.—"Combining with the double jaw spring bolts of a lock and with the levers by which the jaws are opened by the action of the key, a stop tumbler, operated by the key after the jaw bolts have been opened, to hold and keep them apart after the key is taken out of the lock, that the lock may be employed as a stop or dead bolt lock."

52. For an *Improvement in Corn Shellers;* James J. Johnson, Alleghany City, Pa.

Claim.—"The secondary cleaners or pickers, revolved around the cob as the cob is projected by the main cylinder through the opening in the case of the machine."

53. For an *Improvement in Sand Paper Making Machines;* Gilbert D. Jones, Jersey City, New Jersey.

Claim.—"1st, Applying the sand or grit in a heated state to the glued surface of the paper. 2d, The method of depositing the sand upon the glued surface, that is to say, by projecting it forcibly against said surface while in such reversed position, that the excess shall fall off by gravity. 3d, The combination of the stationary pieces, or their equivalent, with the moving drum, the paper, and the glueing cutter."

54. For an *Improvement in Machines for Cutting Out, Punching, and Stamping the Soles and Heels of Boots and Shoes;* Jean Pierre Molliere, Lyons, France; patented in France, July 22, 1853.

Claim.—"The cutting out of soles and heels by the blades from strips of hammered or other leather, sliding between the guide pieces and held in place by the stoppers, the pricking and stamping of the heels and soles, so cut out by the awls and the stamp at the same time, the three operations being performed at one stroke, the detaching from the blades and awls of the pieces cut out, pricked, and stamped by the detaching rods, and the adjustment of the eccentrics upon the shaft, in such manner, that two of the punches can operate in one and the same time."

55. For an *Improvement in Processes for Calico Printing;* Robert Prince, Lowell, Mass., and Ambrose Lovis, Boston, Massachusetts.

Claim.—"The manufacture of silicate of soda or potash containing foreign neutral salts, and the use of this compound with carbonate of soda and neutral salts in dunging operations."

56. For an *Improvement in Machines for Sawing Marble, &c., in Taper Form;* George T. Parsall, Apalachin, New York.

Claim.—"The employment or use of the levers being connected to the sockets of the bars and the uprights of the framing, and the levers being attached to the frame and the framing."

57. For an *Improvement in Packing Pistons for Steam Engines;* Joel W. Pettis, Hillsdale, Michigan.

Claim.—"The arrangement and application of the arms between the packing rings

and a movable centre bearing, whether the said centre bearing be movable to adjust or tighten the packing by means of a central rod passing through a hollow rod, or by other means."

58. For an *Impact Water Wheel;* Atchison Queal, Plymouth, New York.

Claim.—"The sliding buckets placed on the head of the wheel and operated by the inclined semi-circular rod, in combination with the partition. Further, attaching the wheel to the shaft by means of the pins fitting in the hub, the pins being attached to a ball on the shaft."

59. For an *Improvement in Carriage Hubs;* Shepherd W. Reed, Berkshire, N. Y.

Claim.—"The arrangement of the dodged mortises formed on both sides of the permanent projecting flanch or brace by the two angularly shaped projections radiating from the tube for the reception of the spoke tenon, whereby a double row of spokes may be inserted in the hub and supported by the flanch, in combination with the nuts to tighten or lock the spokes, and by which a broken or worn-out spoke may be removed and a new one inserted in its place without untiring the wheel."

60. For an *Improvement in Machines for Cutting Articles from Leather;* Charles Rice, Boston, Mass., and Sylvanus H. Whorf, Roxbury, Massachusetts.

Claim.—"Combining the cutting die with the platen by means of a rotary and adjustable plate, in combination with so applying the pack clamp to its pitman that it may turn thereon when the die or cutter is revolved. Also, the arrangement of the operative mechanism of the pack clamp and that by which the cutter is depressed or elevated."

61. For an *Improved Machine for Carving Wood, &c.;* Isaac M. Singer, City of N. Y.

Claim.—"Combining the tracer with the table which carries the block of wood to be carved by means of two systems of pentagraph levers operating at right angles with each other, whereby the block to be carved will be directed and presented to the action of the cutters in such manner, as to determine the configuration as well in a vertical as in a horizontal direction."

62. For an *Improvement in Corn Shellers;* Jeremiah P. Smith, Hummelstown, Pa.

Claim.—"The combination of the frustrums with their winding wings upon both, and cross projections upon one."

63. For an *Improvement in Slide Valves for Steam Engines;* E. D. Leavitt, Jr., Lowell, Massachusetts.

Claim—"Making the valve and the corresponding parts of the steam chest between which it works, of tapering form laterally, and fitting the valve to its rod in such a manner, as to be capable of lateral movement, whereby the valve is always kept tight between the seat and the back of the steam chest by the pressure of the steam, and the wearing of the rubbing surface is always compensated for."

64. For an *Improved Piano Forte Action;* Francis Taylor, City of New York.

Claim.—"The regulating button permanently connected to, moving with, and governing the fly of the jack in its action on the but of the hammer."

65. For an *Improvement in Auger Handles;* Guillaume Henri Talbot, Boston, Massachusetts; patented in England, August 25, 1855.

Claim.—"The arrangement within the body of the said handle which crosses the bit of the ratchets and pawls with their running gear, for the operation of the bit or bit socket in either direction, either by a revolving or vibratory action of the gimlet handle on pressure of the hand when applied on both sides of the axial line of the bit, and under the usual clutch of the hand on the handle over the centre line of the bit, and whereby the actuating pawls, ratchets, and accompanying devices form no obstruction, and are protected from injury or derangement."

66. For an *Improvement in Cutting Cloaks;* Amasa S. Thompson, Albion, Pa.

Claim.—"Cutting a cloak from a seamless cloth without sleeves, so that by making four cuts of the proper length for the sleeves, the cloak may be worn as a sleeved sack or overcoat by merely changing the buttonings."

67. For an *Improved Manufacture of Cannon;* Daniel Treadwell, London, England.

Claim.—"Constructing cannon with hoops around and shrunk upon a body in which the calibre is formed."

68. For an *Improvement in Devices for Bleaching Ivory;* Wm. M. Welling, Brooklyn, New York.

Claim.—"The method of bleaching ivory plates by so placing and sustaining them on their edges in a suitable case, that the sun's rays shall act with uniform power and bleach said plates equally on both sides, thereby dispensing with the usual method of turning the plates over to expose alternately the flat sides to the action of the light and preventing warping or damage to the ivory, and accomplishing the operation in far less time and more perfectly."

69. For an *Improvement in Chain Making Machines;* Edward Weissenborn, City of New York.

Claim.—"1st, The employment for welding the rings of two rollers grooved spirally in opposite directions. 2d, Arranging one of the end bearings of one of the spirally grooved welding rollers, so as to be capable of sliding lengthwise to the roller, far enough to allow the ring to be slipped over the end of the roller. 3d, The manner of raising, depressing, and confining the upper roller to allow the ring to be slipped over the lower roller, to wit, by means of the rods, the yoke, the spring, and the cam shaft with the cam. 4th, The traveling box, operating to carry the rings quickly over the end of and up to the back end of the welding roller and to come back with the ring at a speed properly corresponding with the velocity of the rollers and pitch of their spiral grooves. 5th, The carrier operating, first, to move forward to receive the ring in its fork, then moving quickly upwards to snatch the ring from the box, and afterwards dragging the ring along the plate, which contains the elongating mechanism, till it comes in contact with one of the elongating parts, or its equivalent, as is thereby, and taken from the fork of the carrier. 6th, The combination of the movable parts and side dies operating to elongate the ring, and at the same time, close or drive towards each other the elongating sides. 7th, The arrangement of the dies round which the link is bent or doubled relatively to the dies, by which the elongated sides of the link are forced towards each other and their attachment to the same, whereby, when the link has received form, it is caused to be in readiness to be bent or doubled by the action of the hooks, or their equivalent. 8th, Operating the parts by which the elongation of the ring is performed by means of a wedge or double inclined piece attached to one of the side dies acting upon studs attached to the slides which carry the said posts, whereby the approach of the side dies towards each other and retreat of the posts from each other are effected simultaneously. 9th, The suspension of the bending hooks at their pivot, and application of a spring to draw the points apart, so that the said hooks will descend in an open state, and will be in condition to receive the link when the latter is sufficiently elongated, but that in ascending and drawing up the ends of the link, they will gradually close, as required by the changing form of the link.

70. For an *Improvement in Rotary Pumps;* C. D. Wright, Fort Atkinson, Wis.

Claim.—"The construction of the pump as shown, viz., the hollow spring placed within an inclined or oblique shell which forms the body of the pump, the sphere being attached to a hollow shaft at one side and communicating with a suction pipe at its opposite side, two opposite sides of the sphere fitting in concaves in the side of the shell, the sphere being also divided into two compartments, one of which communicates with the suction pipe and the other with the force pipe or hollow shell, the sphere having a flanch attached to it, which divides the shell or body into two compartments, and the flanch having a piston working in it, at each side of which apertures are made in the sphere."

71. For an *Improvement in Mosquito Curtains;* John S. Martin, Boston, Mass.

Claim.—"The new or improved manufacture of mosquito curtains as made of two bars, a sheet of cloth or netting, and a series of elastic bands."

72. For a *Method of Adjusting Circular Saws Obliquely to their Shafts;* Amos D. Highfield, Assignor to self and Wm. H. Harrison, Philadelphia, Pennsylvania.

Claim.—"The employment of two beveled washers between a fixed collar on the spindle and the circular saw."

73. For an *Improvement in Harvester Rakers;* John W. Haggard and George Bull, Assignors to Bull, Haggard, and Newsteter, Bloomington, Illinois.

Claim.—"The plate having its inclined and parallel planes on the same sides, in combination with the pin, bar, spring, and pin."

74. For an *Improvement in Variable Cut-Off Gear for Steam Engines;* William W. Wade, Assignor to Wade and Burnham, Springfield, Massachusetts.

Claim.—"The arrangement of the induction and cut-off cams upon two parallel shafts, to operate in a yoke frame containing two separate yokes, one before the other."

75. For an *Improved Machine for Rubbing Types;* Daniel Moore, Brooklyn, N. Y., Assignor to George S. Cameron, Charleston, S. C., James H. McWilliams, City of New York, and Daniel Moore, Brooklyn, New York.

Claim.—"1st, Constructing the slice with openings to receive the type at such an angle, relatively with the directions which said slices move, that the cutters shall commence to act at the latter end of the type covered by said slices, and that the cutting operation shall tend to force the type into the bottom of said angle, and thereby retain the type in place in said slice. 2d, Constructing the slice in such a manner, that the power to force the type in an endways direction, or nearly so, through the cutters, shall be applied to or near the middle of the bottom end of the type. 3d, The follower of slides, and holding plate to supply the machine with a line of type. 4th, The lifter, combined with the gauge fingers and end of the plate or other stop, for the purpose of elevating one type at a time to be taken by the slices.

DECEMBER 18.

76. For an *Improvement in Looms for Weaving Pile Fabrics;* Erastus B. Bigelow, Boston, Massachusetts.

Claim.—"The employment of a latch or hook for successively drawing the pile wire from the cloth. Also, in combination with said latch or hook for drawing out the pile wires, the apparatus which receives the outer or head end of the pile wires from said latch or hook and transfers them to the face of the cloth."

77. For an *Improvement in Grain Cleaning Machines;* Jonathan L. Booth, Cuyahoga Falls, Ohio.

Claim.—"1st, In combination with the fan box enclosing the fan and provided with the hollow shaft through which the grain is fed, the cylinder, shell, and conical basin. 2d, The inverted conical basin with tube or pipe, provided with apertures attached, in combination with the shell, cylinder, and fan box. 3d, Feeding the grain into the space between the shell and cylinder by means of the hollow shaft and arms, whereby the grain is evenly fed into said space without interrupting or obstructing the current or blast which passes up through the cylinder, and the machine, also, rendered compact and efficient."

78. For an *Improved Saw Set;* T. C. Bush, New London, Connecticut.

Claim.—"The additional guard or stop, so constructed and arranged, as to enable the operator to set the teeth of a saw, alternately, in each direction without reversing the instrument or the saw."

79. For an *Improved Nozzle for Exhaust Pipes of Locomotives;* William E. Cooper, Dunkirk, New York.

Claim.—"The blast nozzle which forms the escaping steam into a circle, or its equivalent, and permits the products of combustion to pass up both sides of the annular steam track or current."

80. For an *Improvement in Paddle Wheels;* Frederic W. Capon, Newton, Mass.

Claim.—"The combination of one or more alleviators or skeleton paddles with each or any main paddle or float of a paddle wheel or propeller."

81. For an *Improvement in Fire Arms;* Joseph C. Day, Hackettstown, New Jersey.

Claim.—"1st, Connecting the two side pieces between which the barrel is hung by a hinge, and locking them by the projection and a corresponding recess. 2d, Making the face of the sliding collar of the shape of an arc with a cutting edge, so as to act in combination with the rear end of the cartridge. 3d, The grooves in the breech and the rear end of the barrel."

82. For an *Improvement in Piano Fortes;* Spencer B. Driggs, Detroit, Michigan; patented in England, November 1, 1855.

Claim.—"1st, Securing the sounding board within a metallic frame, or its equiva-

lent. 2d, Combining the sounding board and its inclosing frame with upward projections, from an open metallic base frame, and with a wrest plank and an upper metallic frame or hitch plate, by which I am enabled to make a piano forte without using wooden blocks or other wooden supports for the wrest plank, sounding board, and upper metallic frame. 3d, In connexion with the combination of the upward projections from the open metallic base frame with the metallic sounding board frame, the wrest plank and the upper metallic frame, I claim combining a thin bottom board with a shallow wooden frame, which incloses the said open metallic base frame. 4th, In connexion with the inclosure of the thin sounding board within a metallic frame, and the combination of said frame with the upper metallic frame, the wrest plank and the open metallic base frame, I claim the combination of the said inclosed sounding board with the thin bottom board of the instrument by means of a sounding post, for the purpose of adding additional stiffness and vibratory power to both of said boards. 5th, Supporting the strings upon metallic saddles, which stride the sounding board bridge and are combined with said bridge and with the sounding board."

83. For an *Adjustable Crank Piece for Augers;* John Gourlay, Ogdensburgh, N. Y.

Claim.—"The particular method of varying the length of leverage in handles."

84. For an *Improved Automatic Feed Motion for Saw Mills;* Henry C. Green, Clarence, Wisconsin.

Claim.—"The combination of the cones, governor, and pulleys."

85. For an *Improvement in Spike Machines;* A. M. George, City of New York.

Claim.—"The friction roller and lever, to which the cutter is attached when said roller and lever are placed upon adjustable centres, or pivots, or rods."

86. For a *Machine for Measuring Music;* H. B. Horton, Akron, Ohio.

Claim.—"Attaching the markers by which the notes are registered to light springs or flexible bars, which are so supported by the keys, when the latter are raised or not in operation, as to hold the points out of contact with the roll or other traveling sheet upon which the notes are registered until their respective keys are depressed, when losing that support, the points fall or are gently pressed upon the surface of the sheet. 2d, The method of operating the "bar marker" by which the bars are registered, by making it sufficiently elastic to hold the point off the sheet while it is left free, and striking it down in contact with the sheet, at intervals of time, bearing a proper relation to the movement of the sheet, by means of a hammer, and operated by a cam on one of the rollers which supports and moves or is moved by the sheet. 3d, The revolving vibrating indicator, arranged so as to be visible by the player, and the cam on the axle of one of the rollers, which drives or is driven by the sheet for the purpose of marking the time to lead or guide the player. 4th, Attaching all the note markers, and the bar marker, and the upper guide of the rods, through which the keys support the note markers to a frame, so that the whole can be moved simultaneously in a lateral direction to mark in different lines."

87. For a *Machine for Planing Felloes;* Wm. W. Johnson, Clifford, Pa.

Claim.—"The combination of the lever sliding in the arms, with the graduated lever and hollow cylinder or barrel being hinged, or any device substantially the same."

88. For an *Improvement in Moulds for Casting Bells;* Eber Jones, Troy, N. Y.

Claim.—"The so making of flasks for casting bells, the bodies of which are made of metal, so that the guides by which they are put together, shall be turned or moulded from the same centres from which the flasks themselves are coated with the lining or covering of clay or loam, and forming said guiding surfaces, where they are constantly under the ready inspection of the moulder."

89. For an *Improvement in Machines for Stuffing Horse Collars;* S. B. McCorkle, Greenville, Tennessee.

Claim.—"The cylinder provided with teeth or rods, and operated by the roller, lever, arm, and ratchet, for the purpose of feeding the straw to the plunger."

90. For an *Improvement in Machines for Polishing and Burnishing the Edges of Soles and Heels of Boots and Shoes;* Jean Pierre Molliere, Lyons, France; patented in France, January 5, 1855.

Claim.—"The rotary hollow tools, capable of being heated to any degree by the ad-

mission of steam, or other heating medium, into the chambers through the hollow shafts on which they turn from the regulating valve cocks, for the purpose of polishing and burnishing the edges of soles and heels of boots and shoes."

91. For an *Improvement in Machines for Mounting the "Uppers" of Boots and Shoes on Lasts;* Jean Pierre Molliere, Lyons, France; patented in France, August 19, 1854.

Claim.—"The arrangement of the adjustable frame and thumb screw armed with the toothed clamp, which, pressing vertically upon the inner portion only of the heel, holds the last securely in its position, and gives free access to the parts thereof on which any work is to be done by the apparatus."

92. For an *Improvement in Stone Dressing Machines;* Oldin Nichols, Lowell, Mass. and Ammi M. George, Nashua, New Hampshire.

Claim.—"The combination of the movable and djustable eccentrics with the toggle joints for operating or driving stone dressing tools."

93. For an *Improvement in Instruments for Modifying Focal Length of the Eye;* Daniel Parish, City of New York.

Claim.—"The improved optical instrument herein described, for the purpose of improving and restoring the sight by giving greater convexity to the eye when flattened, and also, by depressing that organ when too convex."

94. For an *Improvement in Mill Spindle Steps;* Isaac N. Parker, Lewiston, Maine.

Claim.—"The formation in the step of the oil reservoir surrounding but separated from the spindle, and communicating with it by the opening at its bottom with the periphery of the spindle."

95. For an *Improvement in Horse Powers;* Samuel Pelton, New Windsor, Md.

Claim.—"The improvement, consisting in centering the wheels and pinions upon their several axles and bearings by beveling or dishing the wheels and extending their bearings, whereby the pressure is equalized upon the journals above and below each pinion and wheel, thereby preventing the unequal wear of the axles and journals, consequently, avoiding every tendency of the gearing to twist and break. Also, the mode of constructing and attaching the levers."

96. For an *Improvement in Automatic Gate for Railroad Crossings;* George B. Pullinger, Philadelphia, Pennsylvania.

Claim.—"The combination of the mechanism attached to the railroad track and operated upon by the locomotive or cars, for detaching from and bringing in contact the notched end of the lever with the end of the vibrating lever, with the upright spring levers, studs or projections on the ends of the flaps, and the means of operating the flaps and gates, or barrier bars, so as to enable the said gates or barrier bars to be depressed by the weight of the horse or other object when no danger is to be apprehended from the near approach of the locomotive or cars, but prevent the said gates or barrier bars being depressed to allow the passage on the track of any object, after the locomotive or cars having reached a point on the track sufficiently near the crossing to render the passage of such object unsafe, and not allow the said object to depress the gate or barrier bar through the agency of the inner flaps to get out from between the same, in case the locomotive or cars should have reached the point where it operates on the inclined bars, to prevent the depression of the outer flaps, and, consequently, of the gates or barrier bars, through this agency, until after the passage by the crossing of the said locomotive and cars."

97. For a *Plane for Finishing Grooves in Patterns, &c.;* John P. Robinson, Matteawan, New York.

Claim.—"Constructing the plane stock of triangular or three-sided prismatic form, the two lower sides forming a greater or less angle with each other and the plane iron fitted in the stock."

98. For a *Shingle Machine;* Joel Tiffany and Milo Harris, Painesville, Ohio.

Claim.—"Providing a primary and secondary set of knives, a primary and secondary set of feed rollers, and obliquely grooved driver, a primary feed carriage, and a pair of secondary feed grippers."

99. For an *Improvement in Organ Melodeons;* Thomas F. Thornton, Buffalo, N. Y.

Claim.—"Providing an additional set of valves and one or more additional sets of reeds, in a position the reverse of the usual arrangement of reeds, and extending the keys backwards in rear of the fulcrum, to actuate the additional set of valves through push-up pins, to play on the additional set or sets of reeds at the same time as they actuate the other sets of valves through the push-down pins to play the c, c, which are below them."

100. For *Improved Piano Fortes;* Hubert Schonacker, Detroit, Michigan.

Claim.—"Constructing the instrument, so that the strings shall rest on a fret at the nodal or octave points, or substantially similar rest upon the bridge of the sounding board, whereby free vibration is allowed to the whole length between the hitch pins and bridge on the wrest plank. 2d, The connexion of the two strings with the same screw when that is combined with the employment of a fret or other rest, merely supporting the string on the sounding board at single points and not confining it."

101. For an *Improvement in Treating Galena or Lead Ore;* Julius E. Schowbe, City of New York.

Claim.—"The method of treating galena by means of common salt, or its chemical equivalent, and sulphuric acid."

102. For an *Improvement in Attaching Hubs to Axles;* Eliphalet S. Scripture, Green Point, New York.

Claim.—"The plate jointed or formed of two parts and provided with flanches, in combination with the shield, collar, and gasket."

103. For an *Improvement in Felting Hat Bodies;* Isaac Searles, Newark, N. J.

Claim.—"The combination of the circular revolving bed with one or more planking tables, and one or more cones."

104. For an *Improved Saw-Set;* Isaac Spaulding, Saratoga Springs, New York.

Claim—"The construction of the slides and their arrangement with the screws and punch."

105. For an *Improved Horse Collar;* Samuel Shattuc, Henrietta, Ohio.

Claim.—"The key, screw key, and section provided with the projections, and combined with the washer, constituting a jointed collar."

106. For an *Improvement in Sewing Machines;* Isaac M. Singer, City of New York.

Claim.—"The mode of operation for forming seams by alternately making a long forward and then a short back stitch by means of an eye pointed needle, which merely carries a part of its thread through the cloth or other substance, that it may be interlaced or concatenated, whether the said mode of operation be applied, or any equivalent therefor."

107. For an *Improvement in Suckers for Pumps;* Joseph Weis, Bordentown, N. J.

Claim.—"The wedge-shaped block with any convenient number of wings, in combination with the perforated hollow cone and the similarly shaped piece of gum elastic or other similar substance, to be applied as buckets or valves for pumps."

108. For an *Improvement in Locks;* Thomas Bowles, Assignor to Robert M. Patrick, City of New York.

Claim.—"The shutter so arranged, that, being brought into action when the bolt is withdrawn, it shall cover the key hole, while the bolt is so withdrawn. Also, the arrangement for withdrawing the bolt by a distinct movement of the key after the tumblers have been set, such arrangement consisting of the lever, in combination with the link and the bolt."

109. For *Improved Arrangements and Combinations of Machinery for Regulating Velocity of Wind Mills;* Jeremiah Burnit, Assignor to self and James Clark, Pusey-ville, Pennsylvania.

Claim.—"1st, Causing the vanes or sails to traverse automatically from or towards the centre of the wind wheel. Also, in connexion with the centripetal and centrifugal

traversing of the sails or vanes, the vertical adjustment of the same, viz., causing the double lattices, of which the vanes are composed, to expose more or less surface to the wind by making the slats of one cover more or less the openings in the other."

110. For an *Improvement in Woven Fabrics;* John Healey, Bolton-le-Moors, England, Assignor to James Bishop, New Brunswick, N. J.; patented in England, November 17, 1846.

Claim.—"The improvement in the woven fabric, in which the weft is placed in a diagonal position to the warp."

111. For an *Improvement in Cooking Stoves;* John B. Lancaster, Administrator of John R. Lancaster, deceased, Tampa, Florida.

Claim.—"The arrangement of parts."

112. For an *Improvement in Lamp Extinguishers;* Elijah Richmond, Assignor to Ira Noyes, Abington, Massachusetts.

Claim.—"Attaching to the cap or extinguisher, a tube placed at any desired angle with the same, leaving a clear space between the cap and its tube, whereby the cap or extinguisher can be applied to or removed from the wick without removing the said cap tube from the wick tube."

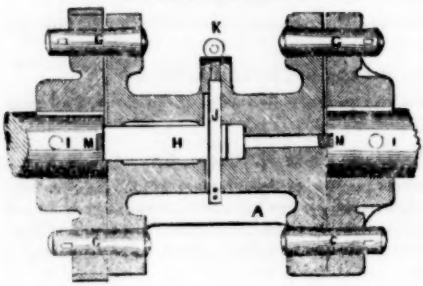
MECHANICS, PHYSICS, AND CHEMISTRY.

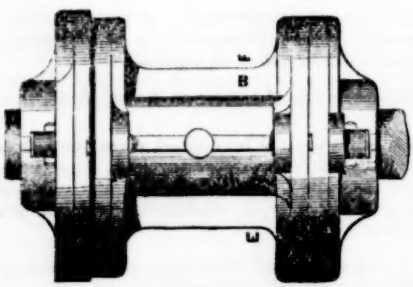
*Coupling Screw Propeller Shafts.**

To the Editor of the Artizan.

SIR:—Enclosed I have sent you, for publication in your valuable *Journal*, a sketch of a simple plan for coupling screw shafts to ½-in. scale.

Longitudinal Section



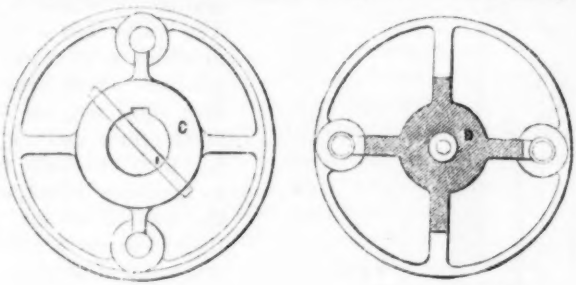


Plan.

A represents a section of intermediate distance piece, which is intended to be placed between the engine and propeller shaft; B, plan; C, end view of coupling bosses on propeller and engine shafts; D, section through (E, F); *g g g g*, pins for connecting it to bosses on propeller and engine shafts; *h*, pin fitted in the inside of intermediate distance piece *loose*, the one end of which fits into a recess in end of propeller shaft, for the purpose of keeping the surfaces apart when the propeller shaft gets disconnected, to prevent friction that would be caused should the surfaces come in contact; *j*, cotter, for cottering up pin, *h*; *i i*, pins for preventing coupling bosses from being drawn off when the engines are reversed, and also when the pro-

* From the London Artizan, August, 1855.

peller shaft is being drawn in, which will have to be done by two long screwed bolts and nuts for that purpose, which are not shown; *k*, eye-bolt for lifting out intermediate distance piece; *l*, friction strap for holding or preventing the propeller from revolving whilst being connected or disconnected; *m m*, pins to prevent the engineers from making a mistake



End View. Traverse Section.

in putting the intermediate distance piece into its place: these pins are intended to be fitted into grooves, cut in the front surfaces of connecting bosses, extending from edge to centre, as shown; by that means it can enter but one way.

It is my opinion that if this plan were introduced in the mercantile screw-steamers, it would be the means of saving much time and expense in connecting and disconnecting screw shafts, and prevent injury to the bearings.

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*Bellhouse and Cowburn's Oscillating Safety Valve for Steam Boilers.**

A Safety Oscillating Float Valve of similar principle to those hereinafter described was invented by Messrs. Bellhouse and Cowburn about two years ago; since that time they have perfected the idea, and have produced an oscillating safety valve which possesses the merits of being simple, not easily deranged, and certain in its action. One variety of this valve is represented in fig. 1 of the annexed engravings, and consists of a spherical valve *a*, fitted upon a concave seating *b*, on the top of a tube *c*, rising from the boiler. The valve is loaded by annular-shaped weights *d*, dropped over the bell-shaped cover *e*, which is connected by ribs to the spherical valve *a*. The weights thus act directly upon the valve without the intervention of a lever. When the steam rises to a dangerous pressure it affects the valve by imparting to it an oscillating and revolving motion upon its seating, thus forming a lateral crescent-shaped opening between the valve and its seating, which admits of the escape of steam, and at the same time keeps both valve and seating clean and free from tendency to adhesion. The suspension of the weights at a level below the valve itself, causes it to find its own level and adjust itself, should the valve from any cause get out of plumb. This description of valve is further provided with levers and float, so arranged, that should the water in the boiler descend to a dangerous level, the valve will be opened, and the steam will escape.

* From the Lond. Civ. Eng. and Arch. Jour., August, 1855.

In a second variety of this combination of the vacuum and float valve, the steam acts on the upper surface of the valve, which is recessed on its under side, so as to leave the spherical portion of the valve as narrow as the concave seating on which it is fitted. The valve has a cross-head, to which is attached a forked pendant, which forms one arm of a rigid angular lever, the other arm consisting of a tube in which are balls which act as movable ballast, and assist the motion of the valve by their impetus in rolling to the other end of the tube. A float is attached to the end of the tubular arm, and when the water level descends to a dangerous point the action of the levers causes the spherical valve to slide on its concave seating, thereby forming lateral crescent-shaped openings through which steam will be emitted from the inside of the boiler; or should there be a vacuum in the boiler, air will be admitted from the exterior atmosphere.

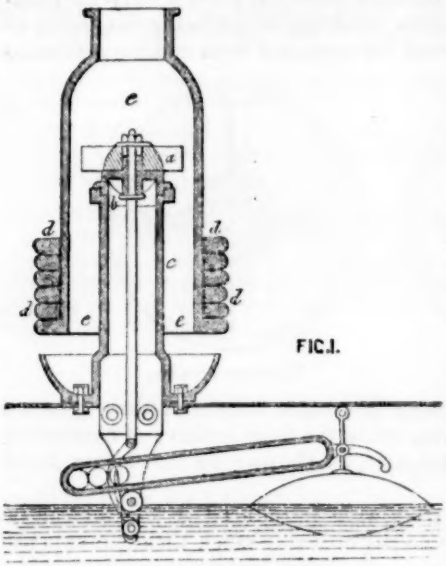
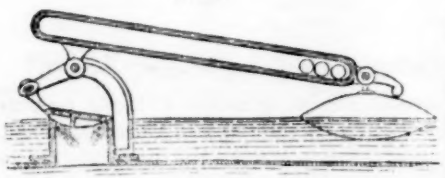


FIG.1.

FIG.2.



A third modification of Messrs. Bellhouse and Cowburn's vacuum and float valve is shown in fig. 2. This valve is designed to act under water, being generally placed over the fire-box or flue of the boiler, and acting in a manner similar to those already described, allowing of the escape of the water and steam, or of the entrance of air, as the case may require. The valve may have leaden or other fusible metal plugs, run into tapered holes as shown, which will provide an additional security.

These patent valves are much approved of in Manchester, upwards of 200 of them having been applied to steam and other boilers in that neighborhood, within the last twelve months.

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*Removal of Stains of Nitrate of Silver.**

For this purpose the following solutions may be employed:—A solution of 8 parts of perchloride of mercury and muriate of ammonia in 125 parts of water, or one of 5 grms. of cyanide of potassium and 50 centigrms. of iodine in 45 grms. of water.—*Journ. de Pharm. d'Anvers*, October, 1854.

* From the Chem. Gaz. No. 310.

Manufacture of Gas. Patented June 23, 1854. By THOMAS ISAAC DIMSDALE.*

This invention has for its object to increase the volume of the gas obtainable from carboniferous or bituminous substances, by means of a novel mode of applying known chemical principles to the production of gas for both heating and lighting purposes. The production of gas for both these purposes is effected by one continuous operation, and in a simpler, cheaper, and therefore more practical way (consistent with the easy adaptation of the invention to the existing apparatus in gas works) than has hitherto been done. The decomposition of water when heated to various degrees by passing it over incandescent charcoal, to obtain hydrogen gas and otherwise, as auxiliary to these purposes, has not been hitherto effected in a manner to bring the process into anything like general use. One difficulty has been the high value of charcoal, which, by the great majority of experienced gas manufacturers, has been found to render the cost of obtaining the gas, greater than when coals are employed in the usual method.

In carrying out this invention, steam is generated in an ordinary low-pressure steam-boiler, and it is conveyed by a horizontal iron pipe immediately over or under the groups of retorts, as they are now arranged in gas manufactories. This pipe may be well covered with felt, or any substance which is a non-conductor of heat, in order to prevent the steam from experiencing any material loss of temperature during its passage along the pipe. From this horizontal pipe smaller perpendicular short branch pipes, provided with stop-cocks, are made to ascend or descend towards the centre of the retorts. These branch pipes are to be connected, by a screw-joint, with a pipe passing through the lid or top of the retort, along the top inside, then down at the back, where the pipe is divided into three pipes that pass along the bottom. These bottom pipes are perforated with very fine holes underneath, so as to permit the escape of steam, and their ends are closed. When the retorts are not at work, the small perpendicular pipes can be disconnected from the pipes in the retort and taken off; and the stop-cocks close to the horizontal pipe being turned off, all escape of steam will be prevented. The retorts are to be charged, in the usual way, with bituminous shale or schist, boghead, cannel, or ordinary coal, and heated precisely in the manner now done. When the retort has become thoroughly hot, and the mass of the substance within heated through, or nearly through, to a red heat, the stop-cocks communicating with the horizontal steam-pipes are to be turned on, and the steam admitted: the result of this will be, that the steam will become super-heated in its passage through the pipe placed inside at the crown or top of the retort, and after descending through the pipe at the back of the retort, the super-heated steam will ascend through the incandescent mass in the retorts from the small apertures pierced in the lower pipes. The steam will be thereby decomposed, and hydrogen and oxide of carbon gases be evolved, which will combine with and increase the volume of gas being produced by the destructive distillation of the substance with which the retorts have been charged. From bitu-

* From the Lond. Civ. Eng. and Arch. Jour., August, 1855.

minous coal, schist, or shale, a thick heavy gas is produced, rich in illuminating power, and the addition of the hydrogen and oxide of carbon gases, will not materially diminish the illuminating power, and by no means in proportion to the increase of volume they afford. Up to a certain duration of the process (being nearly that at which the operation would cease for making gas under the old and usual mode) the increase obtained in volume will vary in amount, according to the quality of the substance with which the retort is charged, from twenty to thirty per cent., before any apparent diminution of lighting power will occur, or so as to render the gas unsuitable for illuminating purposes. When the decrease in lighting power has reached to this point, the communication between the retorts and the gas holders, which received gas intended for lighting, is to be shut off, and the gas subsequently produced should be conveyed into a separate gas holder, which gas will now be applicable to heating purposes. This gas will be of greater heating power than carburetted hydrogen; and the quantity produced by the continued passage of the super-heated steam through the incandescent mass in the retorts, will amount to more than the volume of the lighting gas transmitted to the first gas holder. Thus, assuming that the quantity of gas which would have been yielded under the old and ordinary process of gas making, to be nine thousand cubic feet per ton of ordinary coal, the quantity suitable for lighting purposes will be increased up to nearly eleven or twelve thousand cubic feet, and the produce from bituminous schist or shale, augmented from five thousand or six thousand to seven thousand or eight thousand feet; and the quantity of gas for heating purposes yielded besides, will be at least an equal quantity more. If the material to be carbonized be peat, lignite, or other carbonaceous substance, yielding gas of feeble illuminating power, it may be saturated previous to being put in the retort, or partly saturated, with any dissolved resinous, oleaginous, or fatty matter, or a proportion of boghead coal mixed therewith, with or without such saturation, and then heated in the manner above described. The ash or charcoal of boghead coal or shale, which has been perviously used and exhausted of all the gas it will yield suitable for lighting, may be again used for producing gas for heating. The charcoal obtained from lignite, peat, or wood, when in an incandescent state, being capable of decomposing the steam of water, may all be used in the above described manner for that purpose; and if the gas be required for illuminating purposes, it may be carburetted by putting into the retort with these matters, dried peat in small lumps, or pulverized sawdust, or ground charcoal saturated with any oleaginous, fatty, resinous, or tarry matter, or with naphtha. The fatty, oleaginous, resinous, or tarry matters should be mixed with the dried peat, sawdust, charcoal, or other solid carbonaceous substances, before the latter are placed in the retort, and not added thereto while in the retort.

Claims.—The method described, of operating upon carbonaceous or bituminous substances (capable of yielding combustible gas for lighting and heating), by the introduction into the retort, during the process of distillation, of jets of super-heated steam, for the purpose of decomposing the same, and causing its elements to combine in a nascent state with the gases evolved from the carbonaceous or bituminous substances contained

in such retort. Also, mixing with solid carbonaceous matters, as above set forth, fatty, oleaginous, or resinous substances, previous to the same being placed in the retorts, for the production of gas.

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*Aluminium, the so-called New Metal.**

Marvels (if we may judge from the eager manner in which they are received by the bulk of mankind) are the natural food for the sustentation and quickening of many minds. There are few among us who cannot testify to the charm of a really marvellous story. It is indeed quite vexing, while soaring pleasantly in imagination, far from facts and figures, to be brought suddenly, by some friendly monition, into the presence of stern realities, and thereby convinced that we have been merely dreaming. If, however, we do not desire to have our visions thus rudely dispelled, we must choose for our ruminations some field which will not admit of the facile demonstration of the impracticable or impossible. In short, it is injudicious, whatever custom may say to the contrary, to feed the marvellous vein of craving humanity with fictions based upon supposititious progress made in the applied sciences; and that for the simple reason that the deceit, whatever it may be, is so readily discoverable. This, we think, is well understood by all persons engaged in practical science; for whatever class else of the community may take on trust the announcements of wonderful discoveries put forth from time to time, whether they relate to flying machines, the long range, or perpetual motion, we are sure it is not the followers of chemistry or mechanics who place the slightest faith in such fictions. They, however, are subject to fall into an error of an opposite kind, and distrust the value of every suggestion that has not been put to actual trial. This is more especially the case when very important advantages are declared to be attainable by the adoption of some new proposition; for knowing, by experience, how gradual has been the progress in the arts, practical and scientific men are unprepared for great changes; and thus, from their discrediting unattested statements, many valuable discoveries have long been kept in abeyance.

The recent proposition for the adoption into the arts of the metal aluminium, has afforded to the lovers of the marvellous a new subject for speculation. Already its adaptability to a hundred cases is proclaimed, although the difficulty of obtaining it is at present a bar to its use. It is sufficient that the compounds of the metal are capable of being reduced and made to yield the pure metal; that the metal thus obtained is white, tough, not readily oxidizable, and has a lighter specific gravity than iron: and from these facts a world of probabilities as to its ultimate range of application, has been put forth. We remember, some years ago, when the great and unexpected yield of copper at the Burra Burra mines affected, for a time, the market price of that metal, the public was promised penny-pieces as large as dinner plates. But, far from that, copper has actually advanced in price, and that to a permanent and inconvenient degree; while gold—notwithstanding the prophecies respecting the change which the enormous additions made to it of late

* From Newton's London Journal of Arts and Sciences, September, 1855.

years would effect in its market price—still retains its relative value amongst the metals, and has hitherto, as far as we remember, found no new application in the arts to the displacement of any other metal; although its natural peculiarities render it eminently adapted to a variety of untried uses. We are led to make these remarks in order to abate public expectation respecting the prominent position that aluminium will quickly take in our manufactures. When a ready means has been found to obtain the metal at a price, numerous difficulties may even then present themselves, and call for the exercise of great ingenuity and patience to master them. This was the case with zinc, which, although well known to the ancients, and employed for so many centuries in the production of alloys, has only of late come into extensive use, owing to the difficulties which had to be enconntered in its manipulation. But while many enthusiasts are busy in extolling the merits of aluminium as the latest treasure wrested from the store-house of nature, we think it not unlikely that those whose interest its discovery may most nearly concern, will, instead of testing its value by experiment, ignore its very existence until it has forced its way into notice. It is just one of those discoveries which no manufacturer could afford to pursue at his own expense, and for the simple reason that he would gain no equivalent for his labor, because all would participate alike with him in the benefit of his researches. We are glad, therefore, to find that the French Government, in its provident care for the advancement of science, has been at the cost of a series of experiments for ascertaining the best means of reducing aluminium from its compounds to the metallic state. It is at present premature to pronounce an opinion as to the future value of this metal in the arts; but as nothing can give a greater impetus to manufacturing industry in its present advanced state than the introduction and use of new natural products, we propose to lay before our readers the gleanings of the foreign journals, which treat of the properties of aluminium, and the mode of obtaining it from its natural combinations.

This metal, which, owing to the recent researches of M. St. Claire Deville, is now exciting so much attention, was discovered, or rather, its existence was inferred, by Sir H. Davey; and the correctness of his inference was confirmed by M. Wohler, who obtained aluminium in a pulverulent state by treating its chloride with potassium. By modifying M. Wohler's process, says M. St. Claire Deville, the decomposition of the chloride may be regulated in such manner as to produce a degree of incandescence that will cause the particles of the metal to agglomerate and take the form of globules. On heating a mass, composed of the metal and chloride of sodium (which is to be employed by preference,) in a porcelain crucible, to a lively red heat, the excess of chloride of aluminium will be disengaged, and a saline mass, with acid re-action, will remain, in which will be found globules of perfectly pure aluminium. This metal is as white as silver, and eminently malleable and ductile. Nevertheless, on working it, it is found to offer greater resistance than silver; and it is therefore supposed to approach nearer to iron in tenacity. It increases in hardness by being worked, but will regain its former condition by the annealing process. The melting point of aluminium approaches that of silver: its density is 2·56: it may be

melted and run off in the open air without undergoing any perceptible oxidation; and it is a very good conductor of heat.

Aluminium is not affected by exposure to either dry or damp air; neither does it tarnish; but it remains perfectly bright, where freshly-cut zinc and tin lose their lustre. It is not affected by the action of sulphuretted hydrogen, nor by hot or cold water. Nitric acid, either weak or concentrated, and weak sulphuric acid, when employed in the cold state, do not act upon it. Its true solvent is hydrochloric acid, from which it disengages the hydrogen, and sesquichloride of aluminium is formed. When heated to redness in hydrochloric acid, in the gaseous state, the product is a dry and volatile sesquichloride of aluminium.

It will be easily understood that a metal which is as white and unchangeable as silver, which is not tarnished by exposure to the air, and which is fusible, malleable, ductile, and tenacious, and possesses the singular property of being lighter than glass, would be exceedingly useful if it were possible to obtain it easily. Besides, considering that this metal exists in nature in large quantities, and that its ore is clay, it is much to be desired that the means should be found for bringing it into common use. The investigations of M. St. Claire Deville have led him to hope that this might be the case, as the chloride of aluminium is decomposed with remarkable facility at a high temperature by the common metals: and a re-action of this nature, which he is striving, with the encouragement of the French Academy of Arts, to realize on a larger scale than a mere laboratory experiment, will solve the question in a practical point of view.

In a subsequent report, made by M. Deville, to the Academy of Arts, he observed that he had caused medals of large size to be struck in aluminium, and also prepared plates of the same, which were not affected by exposure to the air;—and further, that small ingots of the same metal, although handled daily, were found to retain their brilliancy; in fact, this substance was so inoxidizable, that it resisted the action of the air even when heated in a muffle to the temperature employed for assaying gold.

Aluminium will not form an amalgam with mercury, and it takes up but a very small quantity of lead. With copper, it forms light alloys, which are very hard and white, even when 25 per cent. of copper is used. It also has the peculiarity of forming with carbon a grey casting, which is granulous and brittle, very easily crystallizable, and containing silicium, which is separated therefrom in a state of purity, on continuing the action of boiling hydrochloric acid.

The following are two methods given by M. St. Claire Deville, for obtaining this metal:—

I. *Sodium process.*—Introduce into a glass tube of about an inch in diameter, from 200 to 300 grammes of chloride of aluminium, closing the ends with a plug of asbestos; then conduct hydrogen gas, dry, and perfectly free from atmospheric air, into the tube, and heat the chloride of aluminium in this current of gas by means of charcoal. This will have the effect of driving off the hydrochloric acid, chloride of silicium, and chloride of sulphur, with which it is always impregnated. Capsules of as large size as possible, containing each some grammes of sodium,

previously crushed between two sheets of dry filter paper, are then introduced into the glass tube. The tube being full of hydrogen, the sodium is melted; and the chloride of aluminium on being heated, will be distilled and decomposed with incandescence, which may be easily moderated. The operation will be complete when all the sodium has disappeared, and the chloride of sodium formed has absorbed a sufficient quantity of chloride of aluminium to saturate it. The aluminium will now exist in the state of a double chloride of aluminium and sodium, which is a very fusible and volatile compound. The capsules are next to be removed from the glass tube, and placed in a large porcelain tube, furnished with a pipe leading to a receiver. Through this porcelain tube, while heated to a lively red heat, a current of hydrogen, dry, and free from air, is caused to pass; and the chloride of aluminium and sodium will be thereby distilled without decomposition, and collect in the receiver. After the operation, all the aluminium will be found collected in the capsules in the form of large globules: these are washed in water, which will carry off a little of the salt produced by re-action, and also some brown silicium. In order to form a single mass of all these globules, after being cleansed and dried, they are introduced into a capsule of porcelain, into which is put, as a flux, a small quantity of the product of the preceding operation—*i. e.*, of the double chloride of aluminium and sodium. On heating the capsule in a muffle to the temperature of about the melting point of silver, all the globules will be seen to unite into a brilliant mass, which is allowed to cool, and then washed. The melted metal must be kept in a closed porcelain crucible until the vapors of the chloride of aluminium and sodium with which the metal is impregnated have entirely disappeared. The metallic mass will then be found surrounded by a light pellicle of alumina arising from the partial decomposition of the flux.

II. *Process by means of Galvanism.*—This process is carried on by means of the double chloride of aluminium and sodium. For this purpose the aluminium bath is prepared by taking two parts by weight of chloride of aluminium, and adding thereto one part of dry pulverized marine salt. The whole is mixed in a porcelain capsule, heated to about 200 degrees. The combination will soon take place, with disengagement of heat. The liquid thus obtained is to be introduced into a capsule of glazed porcelain, which is maintained at a temperature of about 200 degrees. The negative electrode is a plate of platinum, upon which the aluminium will be deposited, mixed with marine salt, in the form of a greyish layer. The positive electrode consists of a porous vessel, perfectly dry, and containing melted chloride of aluminium and sodium, in which is immersed a cylinder of charcoal, which generates the electricity, and to which pass the chlorine, and a small quantity of chloride of aluminium arising from the decomposition of the double salt. The double fixed chloride is re-constituted, and the vapors cease. A small number of elements are necessary for decomposing the double chloride, which presents but slight resistance to the action of electricity.

When the platinum plate is sufficiently charged with metalliferous deposit, it is removed, and allowed to cool: the saline mass is then cleaned off, and the plate again introduced into the current. The mat-

ter thus detached from the electrode is melted in a porcelain crucible, which is enclosed in an earthenware one; and after cooling, it is treated with water, which dissolves a large quantity of marine salt; and a grey metallic powder is obtained, which is, by several successive meltings, formed into a single mass; the double chloride of aluminium and sodium being employed as a flux for that purpose.

The first portions of metal obtained by this process are nearly always brittle: as fine a product may, however, be obtained by it as by the sodium process; but the chloride of aluminium employed for that purpose must be purer. In fact, by the sodium process, the silicium, sulphur, and iron are carried off by means of the hydrogen,—the iron passing off in the state of protochloride; whilst all these impurities remain in the liquid which is decomposed by the battery, and are carried off along with the first portions of metal reduced.

In addition to these processes of M. Deville, we are enabled to add—*M. Bunsen's method of preparation.*

Take oxide of aluminium, obtained either by the calcination of ammoniacal alum, or from sulphate of alumina, or by the decomposition of alum by chloride of barium; and having mixed it with charcoal, introduce the mixture into a stone retort capable of containing about two quarts, and cover it with a thick layer of cement composed of argil and iron scales. Place the retort in a reverberatory furnace, with its neck projecting horizontally therefrom, from three to five inches, and connect this neck with a glass receiver, for the reception of the chloride of aluminium which is sublimed on the introduction of chlorine. This gas is introduced into the glass receiver by a tube of large diameter, made of glass not easily fusible. The stone retort is heated to a dull red heat, and a current of chlorine (well washed and dried) is caused to pass therein. Chloride of aluminium is then freely formed; and at the expiration of some hours the receiver will contain at least half a pound of product. When this chloride has well cooled, it is mixed with its equivalent of melted and pulverized chloride of sodium, and heat is applied thereto. The mixture will melt at a temperature below 200° Centigrade. It is introduced into a closed porcelain crucible divided into two compartments by a porcelain partition which does not quite reach to the bottom, and closed by means of a porcelain cover, having two holes for the reception of the conductors of the battery. Six or eight pairs of Bunsen's plates will suffice to separate the aluminium. If the temperature remains at 200° Centigrade, the metal will be deposited in the state of powder; and, for the purpose of converting this into a compact mass, pulverized chloride of sodium is gradually introduced into the mixture until the liquid has reached the temperature of the melting point of silver. After cooling, large balls of aluminium will be found in the mass, which are caused to unite by throwing them into melted sea salt. The ingots thus obtained possess all the characteristics of M. Deville's aluminium.

These processes, it will be understood, are suited rather for the laboratory than for the requirements of the arts: but we hope ere long to be able to present our readers with a more practicable plan for obtaining an abundant supply of the metal.

"*Improved Double-action Force Pump.*" By Robert Aytoun.*

The inventor's attention was drawn to this subject in consequence of the bad performance of the common double-action force-pump, which was generally found to be inoperative in the up-stroke, from the presence of air. He stated that he had succeeded in the present machine in rendering the presence of air harmless, and in making both down and up-strokes completely effective, at the same time that the machine itself is more simple and less cumbersome. It consists of an ordinary plunger working through a stuffing box fixed upon the end of a working barrel. The area of the cross section of the working barrel is double that of the plunger. Attached to the lower end of this plunger, and working in the barrel, is an ordinary lifting bucket with valves. Below the working barrel is a stationary valve, and below this, again, is the suction pipe. Near the top of the working barrel, a bent pipe leads to the bottom of the stand of pumps. The action of the pump is as follows:—The plunger being forced through the stuffing box into the barrel, displaces its own bulk of water, and sends it through the bent tube into the stand of pipes; while the lifting bucket, descending with open valves, allows the whole contents of the working barrel to pass through and to get upon its upper side. On the return stroke the whole water in the working barrel is raised by the lifting bucket. One-half of this water serves to fill up the void caused by the simultaneous withdrawal of the plunger, and the other half escapes, as before, through the bent tube into the stand of pipes. Thus a quantity of water is raised at each half stroke of the engine exactly equal in bulk to the plunger. As the upper part of the working barrel where the stuffing-box is situated has at all times a free communication with the water in the stand of pipes, without the intervention of any valve, it is plain that no air can leak through the stuffing-box into the working barrel; and if any air enter through the suction pipe, or wind bore, it will at once rise to the top of the working-barrel, where it will assist by its elasticity in maintaining a continuous flow of water, until it finds its way through the stuffing-box into the atmosphere.

Mr. Landale, M. E., rose and made some remarks in favor of Mr. Aytoun's pump, which, he said, had been lucidly described. It was a pump admirably suited for many purposes, particularly where it could be got at readily, for renewal of cluck and bucket, such as shafts of moderate depth, where the water would not flow over the working parts, and where the pump rods were neither long nor heavy—where they were so, the single plunger was preferable, because the column of water to be lifted balanced the rods. In many situations where the engine was near the pump, and in inclined mines under ground, it was an excellent contrivance, and simple in its parts, and a vast improvement over the old four-valve double-action solid plunger pump, which was a troublesome customer, and very often lost the water on one side, and was being very generally abandoned about collieries. Mr. Landale said, however, that although he knew his friend Mr. Aytoun had really invented it, yet it was not new, as he had had it from Mr. Nelson, of Hyde Park, London, some four years before, and he believed that gentleman had got

*From the Lond. Civ. Eng. and Arch. Journal, September, 1855.

it from some water-works in England, which he could not now name; but it could be easily got at. Mr. Landale also pointed out one similar in principle, recommended in the *Glasgow Mechanic's Magazine;* but it having two sets of rods, two barrels, and too small an area suction cluck, it could not be at all compared with the simplicity of Mr. Aytoun's pump. But neither were new; both he and his brother had been familiar with them for years.

For the Journal of the Franklin Institute.

Particulars of an Iron Steamer.

Hull built by Reaney, Neafie & Co., Philadelphia, Pa. Machinery by the same. Intended service, carrying passengers and freight on the Pacific Coast and Rivers.

HULL.—

Length on deck,	128 feet.	
Breadth of beam,	19 "	6 inches.
Depth of hold,	7 "	
Length of engine space,	43 "	
Draft—estimated forward,	4 "	
" " aft,	4 "	3 "

ENGINES—Two—Inclined cylinders—placed fore and aft.—

Diameter of cylinder,		29 inches.
Length of stroke,	3 feet.	
Maximum pressure of steam in pounds,	30.	
Cut off from commencement of stroke,		18 "

BOILERS—Two—Flue and return flue.—

Length of boilers,	16 feet.	
Breadth "	6 "	
Height " exclusive of steam drum,	7 "	9 inches.
Cubic feet in steam drum,	110 "	
Number of furnaces,	2.	
Breadth "	4 "	9 "
Length of grate bars,	5 "	6 "
Number of flues,	12 in each.	
Internal diameter of flues,		5¼ "
Length of flues	11 "	6 "
Heating surface, 425 cubic feet in each,	850 sq. "	in both.
Diameter of chimney—one,	3 "	
Height "	33 "	

PADDLE WHEELS—of iron.—

Diameter over boards,	18 "	6 inches.
Length of blades,	5 "	3 "
Depth "		15 "
Number "	16.	
Dip of wheels,	2 "	3 "
Average revolutions per minute, estimated,	22.	

Remarks.—Frames $2\frac{3}{4} \times 2\frac{3}{4} \times \frac{3}{8}$ inches and 18 inches apart; 8 strakes of plates from keel to gunwale. Thickness of plates, $\frac{3}{8}$ and $\frac{1}{4}$ inch. Two bulkheads; two box kelsons of wrought iron plates 15 inches high. Valves are worked by Stephenson's link motion. Cabins fitted up with berths for 30 passengers.

The joiner work and plating of hull are entirely fitted, but not fastened, being, what is technically termed, "a knock down," that the parts may be shipped to San Francisco, California, and there set up.

W. J.

For the Journal of the Franklin Institute.

Particulars of an Iron Steamboat.

Hull built by Reaney, Neafie & Co., Philadelphia, Pa. Machinery by the same. Intended service, for carrying freight and passengers on one of the Rivers on the Western Coast.

HULL.—

Length on deck,	100 feet.	
Breadth of beam,	19 "	
Depth of hold,	6 "	
Draft of water forward, estimated,	1 "	6 inches.
" aft, "	1 "	6 "

ENGINES—Two—horizontal.—

Diameter of cylinder,		14 inches.
Length of stroke,	3 feet.	
Maximum pressure of steam in pounds,	65.	
Cut off from commencement of stroke,	2 "	6 "

BOILER—One—flue and tube.—

Length of boiler,	17 feet.	
Breadth "	5 "	3 inches.
Height " exclusive of steam drum,	7 "	
Cubic feet in steam drum,	38½.	
Number of furnaces,	1.	
Breadth of furnace,	4 "	10 "
Length of grate bars,	5 "	
Number of flues or tubes,	36.	
Internal diameter of flues or tubes,		2¾ "
Length of flues or tubes,	12 "	
Heating surface,	520 sq. "	
Diameter of smoke pipe,	2 "	
Height "	25 "	

PADDLE WHEEL—at the stern —

Diameter,	15 "	
Length of blades,	12 "	
Depth "		12 inches.
Number "	13.	
Dip of wheel	1 "	3 "
Average revolutions per minute, estimated,	25.	

Remarks.—Frames, $\frac{5}{8} \times 2\frac{3}{4}$ inches by 1 feet 8 inches apart; 7 strakes of plates from keel to gunwale. Thickness of plates $\frac{4}{16}$ and $\frac{5}{16}$ inch. The bottom stiffened with two wrought iron plate box kelsons 15 inches high.

This boat will run in connexion with the above mentioned, and is, also, a "knock down," intended for shallow river navigation.

The boiler is an arch forward; the engines are on deck, aft, in the usual way for stern-wheel boats.

W. J.

For the Journal of the Franklin Institute.

Particulars of the Steamer Antelope.

Hull built by Samuel Hall. Machinery by Boston Steam Engine Co., Otis Puffit, agent. Intended service, Japan to China.

HULL.—

Length on deck from fore part of stem to after part of stern post above the spar deck,	155 feet.	
Breadth of beam at midship section,	27 "	6 inches.
Depth of hold to spar deck,	10 "	6 "
Length of engine and boiler space,	36 "	
Draft of water at load line,	12 "	
" below pressure and revolutions,	10 "	
Tonnage, (custom house,) 415.		
Contents of bunkers in tons of coal, 75.		
Masts and rig, brigantine.		

ENGINES—Vertical direct.—

Diameter of cylinders,		30 inches.
Length of stroke,	2 feet	2 "
Maximum pressure of steam in pounds, 25.		
" revolutions per minute, 58.		

BOILERS—Two—return flued.—

Length of boilers,	23 feet	6 inches.
Breadth " each,	7 "	
Height " exclusive of steam chimney,	8 "	6 "
Number of furnaces, 2.		
Breadth "	2 "	11 "
Length of grate bars,	6 "	9 "
Internal diameter of flues, 5 upper of		13 "
8 lower of		9 "
2 "		18 "
Length of flues,	18 "	4 "
Diameter of smoke pipe,	3 "	6 "
Height "	22 "	
Description of coal, anthracite or bituminous.		
Combustion, natural draft.		

PROPELLERS.—

Diameter of screw, (Griffith's,)	9 feet.	
Pitch "	19 "	
Number of blades, 2.		

Remarks.—Floor timbers, at throats, *molded* 12 inches; *sided* 10 inches. Distance of frames apart, at centres, 24 inches. Floors filled in solid; water tight bulkheads fore and aft. C. H. H.

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*Coloring of Stone.**

Building-stone may be tinted in different shades by impregnating it with metallic salts, and then adding a precipitating re-agent. By means of salts of lead and copper, with sulphuretted hydrogen, greys, browns, and blacks may be produced. Copper and ferrocyanide of potassium give a red tint. If porous limestones are boiled in solutions of metallic sulphates, carbonic acid is evolved, and the metallic oxide, combined with sulphate of lime, is deeply fixed in the stone. In this manner,

* From the Lond. Artizan, Sept., 1855.

sulphate of iron gives rusty tints, sulphate of copper a fine green, sulphate of manganese a brown, and mixed sulphates of iron and copper a chocolate. The double sulphates thus formed increase the hardness of the stone.

For the Journal of the Franklin Institute.

Particulars of the Steamer Fulton.

Hull built by Smith & Dimond, New York. Machinery by Morgan Iron works, New York. Intended service, Norfolk to Havre.

HULL.—

Length on deck from fore part of stem to after part of stern post above the spar deck,	280 feet 5 inches.
Breadth of beam at midship section, (*molded,*)	42 "
Depth of hold,	24 "
do. to spar deck,	31 "
Length of engine and boiler space,	114 "
Draft of water at load line,	16 "
" " below pressure and revolutions,	16 "
Tonnage 2500.	
Area of immersed midship section at this draft,	630 sq. feet.
Contents of bunkers in tons of coal, 700.	
Masts and rig, Brig.	

ENGINES.—Inclined oscillating, placed fore and aft.

Diameter of cylinders,	65 inches.
Length of stroke,	10 feet.
Maximum pressure of steam in pounds, estimated 20.	
Cut-off at 1½.	
Maximum revolutions per minute, estimated 18.	

BOILERS.—Two—Vertical Tubular—placed fore and aft.

Length of boilers,	30 feet.
Breadth "	12 "
Height " exclusive of steam chimney,	14 "
Number of furnaces, 7.	
Breadth of furnaces,	3 " 6 inches.
Length of grate bars,	7 "
Number of tubes in each boiler, 2500 in after, 1900 in forward.	
Internal diameter of tubes, 2500 of 2 in. and 1900 of 2¼ in.	
Length of tubes,	3 feet.
Heating surface,	9300 sq. feet.
Diameter of smoke pipe,	6 feet 8 inches.
Height,	41 "
Description of coal, Bituminous or Anthracite.	
Combustion, Natural draft.	

PADDLE WHEELS.—

Diameter,	34 feet.
Length of blades,	9 "
Depth "	24 inches.
Number, 28.	

Remarks.—Floor timbers at throats, *molded* 20 ins.; *sided* 10 ins. Distance of frames apart *at centres* 32 ins. Diagonal and double laid iron straps $4\frac{1}{2} \times \frac{3}{4}$ inches. Engines and boilers inclosed in water tight bulkhead. H.

On Nature Printing. By Mr. H. Bradbury.*

Mr. Bradbury's lecture was very long and interesting—and of that special kind which is most difficult to condense. His history of experiments in the art was especially elaborate. He said:—"Nature herself, in her mysterious operations, seems to have given the first hint upon the subject: witness the impressions of ferns so beautifully and accurately to be seen in the coal formations. Experiments to print direct from nature were made as far back as about 250 years—it is certain that the present success of the art is mainly attributable to the general advance of science and the perfection to which it has been brought in particular instances. On account of the great expense attending the production of wood cuts of plants in early times, many naturalists suggested the possibility of making direct use of Nature herself as a copyist. In the 'Book of Art,' of Alexis Pedemontanus, (printed in the year 1572,) and translated into German by Wecker, may be found the *first* recorded hint as to taking impressions of plants. At a later period—in the 'Journal des Voyages,' by M. de Moncoys, in 1650, it is mentioned that one Welkenstein, a Dane, gave instructions in making impressions of plants. The process adopted to produce impressions of plants at this period, consisted in laying out flat and drying the plants. By holding them over the smoke of a candle, or an oil lamp, they became blackened in an equal manner all over; and by being placed between two soft leaves of paper, and by being rubbed down with a smoothing-bone, the soot was imparted to the paper, and the impression of the veins and fibres was so transferred. Linnæus, in his 'Philosophia Botanica,' relates that in America, in 1707, one Hessel made impressions of plants; and between 1728 and 1757, Prof. Kniphof, at Erfurt, who refers to the experiments of Hessel, in conjunction with the bookseller Fünke, established a printing-office for the purpose. Seligmann, an engraver at Nuremberg, in 1748, published in folio plates figures of several leaves he had reduced to skeletons. As he thought it impossible to make drawings sufficiently correct, he took impressions from the leaves in red ink, but no mention is made of the means he adopted. Of the greater part he gave two figures, one of the upper and another of the lower side. About from twenty-five to thirty years later, Hoppe edited his 'Ectypa Plantarum Ratisbonensium,' and also his 'Ectypa Plantarum Selectarum,' the illustrations in which were produced in a manner similar to that employed by Kniphof. These impressions were found also to be durable, but still were defective. The production of impressions could only take place very slowly, as the blacking of the plants with the printer's ball required much time. Rude as the process was, and imperfect the result, it was nevertheless found that the figures thus produced were far more characteristic than any which artists could produce. The fault of the method consisted in its limited application and its incompleteness; since the fragile nature of the prepared plant, if ever so carefully treated, would admit of but very few copies being taken, and where any great number would have been required, many plants must have been prepared, a circumstance which was in itself a great obstacle. In the year 1809 mention is made in Pritzell's

*From the London Athenæum, June, 1855.

'Thesaurus' of *a new method of taking natural Impressions of Plants;* and lastly, in reference to the earlier history of the subject, the attention of scientific men was called to an article, in a work published by Grazer, in 1814, on a 'New Impression of Plants.' Twenty years afterwards, the subject had undergone remarkable change, not only in the mode of operation to be pursued, but also in the result produced,—which consisted in fixing an impression of the prepared plant in a plate of metal by pressure. It appears, on the authority of Prof. Thiele, that Peter Kyhl, a Danish goldsmith and engraver, established at Copenhagen, applied himself for a length of time to the ornamentation of articles in silver ware, and the means he adopted were, taking copies of flat objects of nature and art in plates of metal by means of two steel rollers. Various productions in silver of this process were exposed in the Exhibition of Industry held at Charlottenburgh, in May, 1833. In a manuscript, written by this Danish goldsmith, entitled 'The Description (with forty-six plates) of the method to Copy Flat Objects of Nature and Art,' dated 1st of May, 1833, is suggested the idea of applying this invention to the advancement of science in general. The plates accompanying this description represented printed copies of leaves, of linen and woven stuffs, of laces, of feathers, of birds, scales of fishes, and even of serpent skins."—Passing over a great deal of intervening ground, we come to Mr. Bradbury's conclusion and summary:—"The first practical application of Nature-Printing for illustrating a botanical work, and which has been attended with considerable success, is Chevalier Von Heufler's work on the Mosses collected from the Valley of Arpasch, in Transylvania; the second, (the first in this country,) is the 'Ferns of Great Britain and Ireland,' in course of publication, under the editorship of Dr. Lindley, and printed by Messrs. Bradbury & Evans. Ferns, by their peculiar structure and general flatness, are especially adapted to develop the capabilities of the process, and there is no race of plants where minute accuracy in delineation is of more vital importance than the Ferns; in the distinction of which, the form of indentations, general outline, the exact manner in which repeated subdivision is effected, and most especially the distribution of veins scarcely visible to the naked eye, play the most important part. To express such facts with the necessary accuracy, the art of a Talbot or a Daguerre would have been insufficient until Nature-Printing was brought to its present state of perfection." Mr. Bradbury then adverted to the ingenious and beautiful productions of Felix Abate, of Naples. His Nature representations consist of sections of wood, in which the grain is admirably represented. He terms his peculiar process Thermography, or the Art of Printing by Heat. The process consists in wetting slightly the surface of the wood of which fac-similes are to be made, with any diluted acid or alkali, and then taking an impression upon paper, or calico, or white wood: the impression is quite invisible, but by exposing it for a few instants to a strong heat, the impression appears in a more or less deep tone, according to the strength of the acid or alkali. In this way every gradation of brown from maple to walnut is produced; but for some woods which have a peculiar color, the paper, &c. is to be colored, either before or after the impression, according to the lightest shades of the wood. Abate, in his manipulations, also employs the ordi-

nary dyeing process. It is to be hoped that Abate's process may become alike useful to the natural sciences and the decorative arts. Mr. Bradbury stated, in conclusion, that we are indebted to—Kniphof, for the application of the process in its rude state; Kyhl, for having first made use of steel rollers; Branson, for the suggestion of the electrotype; Leydolt, for the remarkable results he obtained in the representation of flat objects of mineralogy, such as agates, fossils, and petrifactions; Haidinger, for having promptly suggested the impression of a plant into a plate of metal at the very time the *modus operandi* had been provided; Abate, for its application to the representation of different sorts of ornamental woods on woven fabrics, paper and plain wood; Worring, of the Imperial Printing Office, Vienna, for his practical services in carrying out the plans of Leydolt and Haidinger. Nature-Printing may be considered as still in its infancy; but the results already obtained in its application encourage us to expect from continued efforts such further improvements as will place it not least among the Printing Arts.

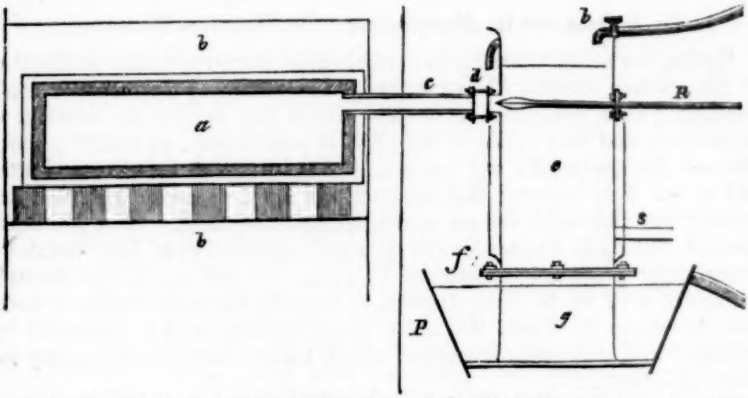
On Sodium and its Manufacture. By WILLIAM BEATSON.

Having for some years given considerable attention to the production of the alkaline metals, I have succeeded in obtaining them (particularly sodium) in such quantities, as to show that it only needed the demand to be created, and they could be supplied in such a way, as would greatly promote the application and extension of science and the chemical arts, and it was only because that demand did not appear to exist, that the subject was allowed to remain in comparative abeyance. Now that such interest has been excited in the enlarged application of Mr. Wohler's process, for preparing aluminium by means of sodium, chiefly through the exertion of M. St. Clair Deville, it may not be uninteresting to indicate the means by which this latter metal, sodium, may be extracted by enlarged and improved processes, which I have been led to employ for some time past.

The retorts, in which the mixture of carb. soda, and coke, has been heated, have been chiefly of malleable iron; but, as it is difficult to obtain these of a large size, retorts of earthenware or fire-clay have been used with success, and probably a fire-clay retort, with a lining or trough of malleable iron, will be found to be the best form of distilling apparatus, though with great care cast iron retorts may yet be employed with advantage. The principal improvement which I have effected, and which is now engaging the attention of M. Deville, consists in making the process continuous; so that the retort is maintained at nearly a uniform temperature, and only requires the introduction of a fresh charge when the previous one has been worked off. If the materials are properly proportioned, the retort becomes nearly empty at the termination of each distillation; or, if an excess of carbon remains in the retort, it is available in the following operation, so that in this way one retort has been kept in full action for a week, and sometimes for nearly a second week, without interruption. As soon as one distillation is completed, and the condenser removed, a fresh charge of soda and carbon is introduced into

the retort, through the same tube as emits the sodium, by means of a long semicircular scoop, and the retort being nearly filled, the new distillation commences in a short time, and proceeds with the greatest regularity and success; the sodium which I have sent to the Paris exhibition, was prepared in this way, and, as before stated, it was only because there seemed to be no demand for the metal, that it was not prepared on an industrial and extensive scale; perhaps, as in some other instances, the supply may create or excite the demand. In addition to the sodium, it is well known that a large quantity of croconates and other compounds of soda distil over and are found mixed with the sodium, and as their separation is tedious in small quantities, I have constructed a large iron cylinder, in which the sodium and its impure admixtures are heated to fusion, below the surface of naphtha or camphine, and a piston or plunger being then forced down by a powerful screw or hydraulic press, the pure metal is found in a mass above, and the impurities in the bottom of the cylinder.

The subjoined figure will explain the method of continuous distillation:—



(*a*) Retort of iron, inside of fire-clay. (*b*) Chamber of reverberatory furnace. (*c*) Eduction tube, attached by screws at (*d*) to the iron receiver (*e*), which is made in two parts, screwed together, and cemented at (*f*), the lower part (*g*), containing naphtha or camphine. (*h*) Tap supplying cold water, which by means of an external case circulates round the condenser (*e*), falling into the pan (*P*). (*R*) Is a strong iron rod, with sharpened steel chisel at the end, for clearing out the eduction tube (*c*). (*s*) Escape tube for incondensible gases. *The Chemist.*

Rotherham, August 14th, 1855.

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*De Tremblay's Mixed Steam and Ether Engine.**

Some years ago the scientific world of London was astonished by the exhibition of a steam engine on an improved principle, in which, by the substitution of certain preparations instead of water, the working cost was

*From the London Mining Journal, No. 1048.

reduced nearly fifty per cent. Whether any thing has been done in this country by the public or the Government we have not heard, but we have received authentic information from Marseilles, that the Societe de Navigation Mixte have just paid 40 per cent. as the present dividend on their original stock, the market price of these shares (nominally of 500 frs. each, but upon which only 133 frs. have been paid) is 650 frs. The subscription list for an issue of increased capital closed on the 10th inst., and the deposit of 50 frs. per share was paid; they are now quoted at 100 frs. premium. All the vessels of this company are engaged in the transport service of the French Government. It would thus appear, that English steam navigation companies are now to be added to railways, and may gain a lesson from the French.

For the Journal of the Franklin Institute.

Mechanical Engineering as applied to Farm Implements. By H. Howson, Civ. Eng.

(Continued from page 405, Vol. XXX.)

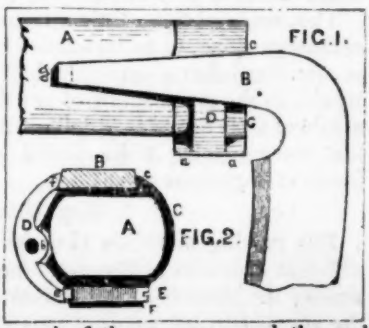
In connexion with agricultural implements, there is a class of inventions, which, although trifling and unimportant in appearance, are well worth a place in these papers, as demonstrating to what an extent and in what minute appliances ingenuity and practical skill have been developed in perfecting various instruments indispensable to the pursuits of husbandry.

In this class may be placed the numerous devices for fastening the blades of scythes to their snaths.

It may appear somewhat singular that for performing this simple operation there should be no less than eighteen or twenty patented contrivances; such is the case, however, and doubtless an examination of the rejected model department of the Patent Office, would divulge the fact that an equal if not greater number of applications for patents for scythe fasteners have been unsuccessful.

In the annexed engraving, Fig. 1 represents a plan, and Fig. 2 a transverse section of a

Scythe Fastener. Patented by B. F. Joslyn, Worcester, Mass., Aug. 1855.



A is a portion of the snath; B, the shank of the blade, having its edges slightly bevelled, and having at its end a projection which fits snugly into a recess in the snath; C, is a hoop shrunk or otherwise secured to the end of the snath, A. On the bottom of this hoop is the lug F, for receiving the tightening screw E. Two other lugs *a a*, are formed on the side of the hoop between which and on the central pin C, is the lever D, the end *e*, of one arm coinciding with the end of the screw E, and the end F of the other arm being shaped to correspond with the bevel of the shank

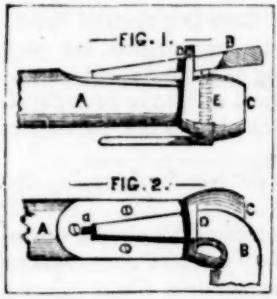
B, which rests on the flat top of the hoop C, and is confined when secured in its proper position between the point F of the lever D, and the beveled lip *c*, on the hoop C, the tightening of the screw E, serving through the action of the lever D, to bind the shank hard against the lip *c*, and the beveled edges of the latter as well as of the point F of the lever, preventing the shank from rising out of its place when thus bound. The superiority of this scythe fastener over others, as claimed by the patentee, is set forth in the following quotation from his specification:

"It will be seen that the shank may be firmly secured to, or removed from the hoop C, on the snath, with the greatest facility by the point of the screw being simply forced against, or withdrawn from the point of the lever; the whole arrangement dispensing with the necessity of boring holes in the hoop (thereby destroying its integrity), and without cutting or otherwise wounding the portion of the snath surrounded by the hoop, both which defects are common to other scythe fasteners."

Annexed are two views of

A Scythe Fastener. Patented by S. B. Bachelor, in February, 1854.

Fig. 1 being a side view, and Fig. 2 a plan.



A, is the snath; B, the shank of the blade which passes through an eye D, in the hoop C. A hook or projection at the end of the shank fits into the longitudinal slot *a*, in the plate or *spotting* on the snath. E, is a screw passing through the hoop C, and binding with its point against the shank in such a manner as to secure the latter firmly to the snath. The advantage claimed by the inventor is that gained by the use of the longitudinal slot *a*, in the spotting which enables blades with shanks of various lengths to be easily attached to the snath.

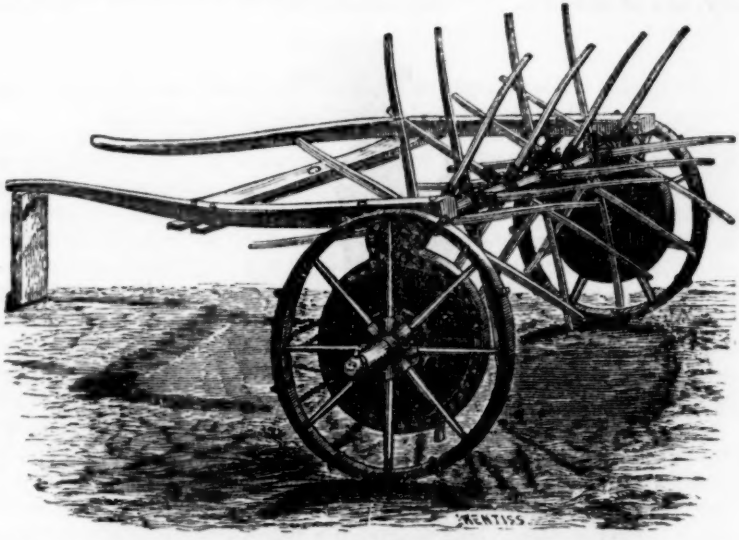
There are various other devices for effecting the object accomplished by the above; devices equally as ingenious, and doubtless, as effective in practice; the two contrivances selected, however, afford an ample illustration of the purport of this class of inventions, and will suffice to show to what minute details the talents of the ingenious have been directed in endeavoring to perfect the most common farm implements.

Thousands of these little attachments are manufactured yearly in Massachusetts alone, to be forwarded to every part of the Union, and when it is considered that a saving of half an hour in the construction of each, would, in the manufacture of one thousand, be, at a moderate calculation, a gain of sixty or seventy dollars, it ceases to be a matter of astonishment, that these seeming trifles should have received so much attention at the hands of ingenious mechanics.

Hay Making Machines.

Hay making machines have for some time been more or less used in different countries in Europe; they have found but little favor, however, among the farmers of the United States. The machine represented in the accompanying perspective view has been employed to some extent in some of the Northern States, and operated with considerable success.

This implement, which has been remodeled from an English machine, and considerably simplified, consists of a pair of substantial shafts suitable for one horse. To the end of each shaft is secured an iron casing, each casing containing a spur wheel and pinion gearing into each other. The pinions are secured one to each end of a stout wooden bar, which



has its bearings in the above mentioned iron casings. On the bar are secured six or more iron sockets a convenient distance apart, each socket having four recesses for receiving a similar number of wooden arms. The spur wheels into which the pinions gear, are loose on stationary axles which project from, and are secured to the iron casings. On the same stationary axles are the main or driving wheels, which have projections from their peripheries, in order to prevent them from slipping off the ground. The driving wheels are so arranged in connexion with the spur wheels that both move simultaneously, so that on drawing the machine over the ground, the spur wheels cause the pinions and the bar on which they are secured, together with its arms, to revolve, and toss whatever mown grass they come in contact with high into the air, thereby distributing it lightly and evenly over the surface of the ground. The machine is made remarkably light and cheap, costing only thirty dollars, and is calculated to spread an acre of hay in twenty minutes.

That every farm implement should be cheap, simple, and at the same time have but little liability to get out of repair, is absolutely necessary. More futile efforts and abortive schemes have resulted from want of attention to the above requisites in designing and constructing agricultural machinery, than any other cause. The constant changes of the weather, the variations of temperature to which such implements are continually exposed, and the class of laborers into whose charge they are frequently placed for operation, dictate the advantages of the most rigid simplicity and durability of construction.

Corn Planters. Patented by Mr. Wakefield, in July, 1854.

Mr. Wakefield has certainly complied with these requisites in designing his ingenious corn planters, which are now manufactured by Messrs. Pascal Morris & Co., the extensive builders of farm implements in this City, and at Reading.

The apparatus as shown in the hand of the operator in the annexed sketch, consists of a light but strong wooden box, which forms the hopper containing the seed to be planted. In front of the box is a guide frame for directing the up and down movement of the embedding bar, which is furnished at the top with a handle for the operator. A partition near the bottom of the instrument separates the hopper from a receiving chamber, and above this partition is a transverse slide, operated by the motion of the embedding bar, on the descent of which the slide allows a fresh supply of grain to drop from the hopper to the receiving chamber, and at the same time the bar ejects the charge of corn previously fed into the chamber, and embeds it in the soil. A projecting flanch at the bottom of the instrument, prevents its planting point from entering too deep into the ground. The operator uses the apparatus as he would an ordinary walking stick, stepping from hill to hill, and striking the point into the ground at the required intervals, and thereby imparting to the embedding bar an up and down movement, by which the hole is made, the seed fed down, and deposited, the seed box closed, and the seed covered with the soil. To explain distinctly the method of performing these several operations, would require explicit detail engravings ; suffice

it to say that the whole contrivance is neat, simple, and seems in every respect well adapted for the purpose intended.

The inventor declares, that with his hand planters, one man will plant four times as much corn, rice, beans, peas, &c., as four men depositing the seed by hand and covering with hoes.

(To be Continued.)

Description of a new Moulding Machine for Cog and other Wheels. By Mr. Peter Rothwell Jackson, Manchester.*

The difficulty that the writer experienced in the course of his practice in not being able to find wheels for driving machinery exactly suited in form, strength, and speed, to the purposes required, (a difficulty that has been extensively felt, notwithstanding the very large and costly stock of wheel patterns existing in this country,) led him, some years since, to investigate the subject with a view to discover if some mode of construction could be adopted which would enable the founder to make cog-wheels from a simple segment of two, three, or more teeth, of any diameter, pitch, breadth, or shape of tooth, without the use of the pattern, in the ordinary way. The result is the machine which is the subject of the present paper.

The process hitherto adopted for making the best cog wheels, (whether spur or bevel-wheels) has been to construct an entire pattern of wood, an exact fac-simile of the wheel to be cast,—having each tooth formed and shaped upon it with great care. In all cases this involves a considerable expenditure, besides requiring very careful stowage till the pattern is next needed; but in the case of large wheels, this becomes a serious consideration, particularly the time required for preparing the pattern, which causes a great addition to the loss and inconvenience occasioned when an accident happens to one of the wheels in a factory,—thereby stopping a large portion of the machinery.

It will be seen that the plan now submitted enables the founder to produce wheels in the shortest possible time, and with a degree of accuracy which is quite unattainable in the usual way, in which patterns are often made in a hurry of imperfectly seasoned timber, and are rarely true, even for a short time; and unless made from timber that has had years to season, constructed with the greatest care, and carefully stored, they soon become valueless.

The proper form of teeth, which, in every case, should depend upon the dimensions of both the wheels which are to work together, can seldom be obtained in the ordinary way, owing to the great expense of good patterns. This often leads to the adoption of a form of tooth which is but an approximation to that degree of truth which is readily attainable by the plan now submitted.

It has often been found that wheels of the same pitch and breadth, but from different makers, will, on this account, not work well together: this difficulty has sometimes been got over by a hand process of chipping and filing (commonly termed pitching and trimming); but such a process,

* From the Journal of Arts and Sciences, August, 1855.

besides the great objection in regard to expense, involves the inaccuracy inevitably attaching to hand work, and has also the objection of removing the hardest and best portion of the metal.

The nearest approach to accurate construction in this direction was, the writer believes, the attempt (formerly made by Mr. Brunton, of Soho), to shape the teeth by a slotting machine, the tool of which was guided by a template of the desired tooth.

To obviate the difficulties that have been referred to, the writer conceived the idea of providing the foundry with a machine capable of producing, with great accuracy, a short segment of pattern, and also of moulding, with equal accuracy, from the segment thus produced, the entire circumference of the wheel required.

This machine consists of a vertical spindle, which carries a circular horizontal table or face-plate, and works in a conical bearing formed in the centre of the frame. The foot of the spindle is separated by four diagonal struts, which extend downwards from the frame, and support the weight of the table, and any thing that may be put upon it, by means of a foot-step, by which the table can be raised at pleasure in the conical bearing in the upper frame,—thereby enabling the workman to turn the table round with very little force and perfect steadiness, though bearing great weight upon it.

Upon a horizontal slide-bed, attached firmly to one side of the frame, moves, by means of a rack and pinion, a sliding jib, which carries at its extremity a vertical slide. On the lower end of this slide the block of wood, out of which the pattern of the teeth is intended to be produced, is fixed; and provision is made for holding it perfectly steady during the operations of cutting the teeth and of moulding, and also for fixing the pattern true and square on any subsequent occasions.

On the under side of the circular table a worm wheel is fixed, for moving round the table, by means of a worm and shaft and change wheels, similar to an ordinary dividing or wheel-cutting machine.

The worm and worm wheel are constructed with great accuracy, and are protected from injury and exposure to any dust of the foundry by a waterlute, consisting of a vertical ring cast upon the under side of the table, and revolving in a small circular trough of water attached to the plate of the lower frame.

By turning the worm shaft the required number of times (having previously adjusted the change wheels so as to suit the number of teeth in the wheel intended to be moulded), the circular table is turned round an interval equal to the pitch of the wheel; and this movement can be accurately repeated in succession through any portion of the circumference.

A block of wood for the segment patterns having been fixed upon the vertical slide, and the slide adjusted at the required distance from the centre of the table, the change wheels also having been arranged to suit the required number of teeth, a cutter is fixed in a horizontal spindle, which revolves in a stand fixed upon the main table at the correct distance from the centre of the table corresponding to the radius of the intended wheel. This cutter is made to revolve rapidly; and the pattern block is then moved down gradually by the vertical slide until a parallel cut is obtained through the entire block—forming one space in the pat-

tern. The block is then raised; and by turning the table round the distance of the pitch, and repeating the cut by passing the slide down again before the cutter, another space is formed; which operation is repeated until all the required spaces are cut in the segment pattern.

The pattern is made to terminate at somewhat less than half a tooth on each side; and a thin metal shield is fixed on each end in the direction of a radius of the circle, projecting about an inch beyond the crown or point of the tooth, for the purpose of preventing the moulder, in the subsequent process of moulding, from disturbing the teeth that he has previously formed in the sand. The formation of the short segment pattern being completed, the cutter and stand are removed, and a moulding box is placed on the table.

In the conical hole in the centre of the table is fitted a bush, in which an upright spindle works,—the purpose being for measuring from it the diameter of the wheel, and for strickling or levelling the sand in the moulding box to form the bottom of the mould of the intended wheel, previous to commencing the moulding of the teeth.

The moulding of the teeth is performed in the following manner:—The segment pattern is depressed until it rests upon the levelled sand forming the bottom of the mould,—the top of the segment being level with the edge of the box; and it is there held firmly. The moulder then rams up, in the ordinary way, that portion of the box opposite the segment pattern, and withdraws the pattern: he then turns the table through a space equal to the number of teeth contained in the segment pattern, and lowers the pattern again, rams up the mould in the fresh position of the box, and so repeats the process until the entire circumference of the wheel is moulded.

In sliding down the pattern into each fresh position, it is prevented from disturbing any portion previously moulded, by its not actually touching the sand; and the shield-plates on each end of the pattern prevent any risk of injury in the process of ramming. These plates leave a narrow channel in the sand—causing a small fin on the centre of the crown of the tooth at that position, which is chipped off by the dresser after casting.

The moulding of the cogs (the essential part of the mould) being thus completed, the box can be removed from the machine, and the moulder can proceed with another wheel, whilst other hands place the cores in the mould already formed. The spaces between these cores form the arms of the wheel, and the centre of the wheel is cored out in the ordinary way: the rim of the wheel is formed by the spaces left between the outer extremities of the cores, and the sand forming the teeth; and the boss or nave is formed by the space between the centre core and the inner ends of the cores.

The top box, having the lower edge turned, is rammed up on a true surface-plate, forming simply a flat top to the mould; and when placed upon the bottom box, the upper edge of which is also turned, and is on a level with the upper surface of the intended wheel, the sand being strickled off to the edge, forms a perfect joint, and, with the cores before named, completes the mould for the wheel.

Bevelled wheels are made by the same system on the machine, from a short bevel segment pattern; to produce which a peculiar cutter-stand is used, admitting of adjustment to any desired bevel; by which, and the machine, the operator is enabled to impart a correct spacing, and very nearly complete the entire segment. The pattern for a bevelled wheel is lifted vertically out of the sand in the same direction as a spur-wheel, and does not slide in the direction of the inclined teeth, on account of the tapered form of the teeth.

Racks can also be made by this machine from a few cogs, by attaching a dividing-screw and change wheels to move the sliding-jib and vertical slide, and fixing the pattern block at right angles to the face of the slide by an angle bracket, so as to mould the rack in a line parallel with the slide-bed.

For moulding very large wheels extending beyond the range of the apparatus, the sliding-jib and carriage are removed altogether, and a horizontal arm fixed on the revolving table, carrying at its outer extremity the pattern slide, which is then moved round by the dividing gear, instead of the moulding box being moved,—the operation of moulding taking place in a circle round the machine. The cutter-stand, for cutting the pattern, in this case is fixed upon the ground, at the proper distance from the centre of the machine, and the pattern is made to move past the cutter, instead of the cutter moving from space to space of the pattern as before.

The following advantages are experienced in moulding by this machine: Each wheel being made from a pattern of its own, specially adapted to work into its fellow, and not with reference to any other wheel, the general principle that any two wheels should have the particular form of teeth that will work best together, can be strictly carried out without difficulty, and at a trifling cost.

The accuracy that has hitherto been with difficulty obtained, even in the best patterns, is by this machine strictly imparted to the sand itself. The teeth, however long or broad, can be drawn out of the mould without any taper allowance whatever, and the workman's attention being directed to a few teeth only at a time, he is more likely to give them special care. The time not unfrequently spent in what is called mending the mould, but which, in fact, from the difficulty of guiding the hand, is too often found to impair the correctness of the work, is thus saved. The result is the production of spur and bevel gear of so much greater accuracy than has been produced by other means, that they can be run at a higher speed than has been hitherto considered advisable in heavy gearing. There is also less need for mortise-wheels, as the noise of gearing proceeds principally from too much clearance, and the want of truth in the teeth.

This plan of moulding allows of H spokes, with flanches round the inner edge of the rim, being adopted, as readily as the ordinary + or T section of spoke. The H spoke makes a stronger wheel, but is not easily obtained by the old system.

Spur-wheels, with shields or flanches to the crown or pitch line, are made with greater facility than by the ordinary process of moulding, as the lower shields are more easily withdrawn, owing to the absence of sand in the centre of the mould.

The large, and in some cases valuable fire-proof buildings, erected for the stowage of wheel patterns, will, by the adoption of this process, be saved, as one machine gives a greater range of pattern than the largest stock contains. This method is useful in enabling the founder to match exactly any old wheel, whether the same have parallel or taper teeth, by forming a short segment pattern to work with it with the greatest correctness practicable, and without having to adapt or modify any previous pattern. It may also be observed, that the breakage of a wheel generally implies a deficiency in strength for the work it has to do; but with the old pattern, the strength cannot well be increased.

In order to show in how short a time a wheel can be produced by this process, an instance may be mentioned of a spur-wheel, for which the following order was sent to the author, by telegraph, from Bristol, on 1st December last:—

"One spur-wheel, twenty-eight cogs, two feet three diameter at pitch-line, cogs two and a quarter long, eight inch broad, six and five-eighths round eye, cast, four arms. Send by rail immediately. Write."

This order was received at the writer's works at 3¼ o'clock in the afternoon. The tin template, steel cutter, and segment to the right size, pitch, and number of cogs were produced; the wheel was moulded and cast, weighing 6½ cwt; and after remaining five hours in the sand, was taken out and dressed, carted nearly two miles, and forwarded by the Bristol train, which left Manchester at half-past nine o'clock the following morning; being a total time of 18¼ hours,—13 hours being the actual time of making the wheel.

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Mr. Jackson exhibited a series of specimens of patterns for spur and bevel-wheels, made by the machine, from ⅜-inch to 4½ inches pitch, and extending to 16 inches in breadth, with the steel cutter used for forming the teeth of one of the patterns, and the tin template from which the cutter was shaped; also a cast wheel, 2 feet 3 inches diameter, that had been moulded on the machine.

He explained, that after having moulded the teeth of a wheel, the further completion of the mould, by inserting the cores for the centre and arms, could either be done on the machine, or after the box was removed, as might be most convenient. Sometimes the wheel had been cast whilst the box remained on the machine, but generally the box was removed as soon as the teeth were moulded, to allow another wheel to be proceeded with, and four or five wheels were sometimes on the floor at once, ready for casting at night, all moulded by the one machine during the day. The core-box for the arms was simple in construction, being made with two sides only, fixed at the required angle, determined by the number of arms, and having an adjustable end and bottom, to suit the different diameters and breadths of wheels.

The Chairman said, he had seen the machine at Mr. Jackson's works, and was much struck with the great accuracy with which the moulding of the teeth was accomplished, the motion of the slide being quite parallel and steady, so that the pattern was drawn out without risk of disturbing the sand. Before seeing the machine, he feared some practical difficulty

in insuring accuracy of the pitch at the several joinings of the pattern; but this was completely provided for by the whole movement of the table, both in moulding and in cutting the pattern, being given by the same dividing wheel, which could be constructed with any degree of accuracy. The machine appeared an excellent mechanical arrangement for obtaining a degree of accuracy in the sand, superior to the ordinary process of moulding; and he thought the work must be truer than in any wheels cast from a pattern built up of pieces. He inquired what was the velocity of the cutter employed in forming the segment pattern, and whether the cutter finished the pattern sufficiently smooth for use.

Mr. Jackson replied, that the cutter was driven at about 1000 revolutions per minute, and the teeth of the pattern were completed at once by the cutter, and not touched by hand, except what was requisite for varnishing the pattern, which was done to protect it from injury by moisture. The cutter was driven by a cord, stretched tight by a sliding-pulley and weight, to allow for the different positions upon the table, required for cutting patterns of different diameters.

He further explained, that in the cutting of bevel-wheel patterns, a cutter, shaped for the small end of the teeth, was used in the same manner as in cutting the patterns for spur-wheels, except that the pattern block was held stationary, and the sliding motion given to the cutter, in a direction corresponding to the inclination of the cone of the intended wheel, by an adjustable slide. The same slide could also be adjusted to carry a second cutter, revolving at right angles to the main cutter, which would finish the ends of the teeth, by cutting them off at proper angles to the face, and at the required length—the cutter-frame being made to travel round with the circular table. The teeth of the pattern were thus pitched out accurately by the machine, and finished at the small ends; and the spaces removed by the cutter were then widened and deepened to a uniform taper towards the other or large ends of the teeth; these large ends being first accurately marked out, by placing, instead of the first steel cutter, a tin template, accurately fitting into its place, and shaped to the correct form, for the large ends of the teeth: this template was then brought down upon each space of the segment pattern in succession, by means of the dividing wheel, and the exact pitch and outline of each tooth carefully scribed from the template.

Mr. Hodgkin asked, whether the teeth of the pattern were dressed by hand to the required taper.

Mr. Jackson said that some part of the work of shaping the teeth in bevel-patterns only was done by hand, but the accuracy of the pattern was not affected, as the man had only to dress them off to a straight edge between two given points, since the teeth were accurately pitched, and cut complete at the smaller end, by the machine; and the position of the template employed for marking out the larger end of each tooth, must in each case truly coincide with the previous position of the cutter, in forming the small end of the tooth, on account of the same movement of the dividing wheel of the machine being employed for the purpose in both cases.

The Chairman suggested the adoption of some different arrangement

of cutter, to enable the tapered teeth to be entirely shaped by the machine, as it was advisable to avoid, if possible, any dependence upon hand-work in forming the pattern.

Mr. Ramsbottom observed that the curve of the tooth in a bevel-wheel being different at every portion of its length, on account of the whole tooth being tapered both in breadth and depth, caused the difficulty in cutting by machinery, as no cutter could be passed through in the ordinary way, except the one fitting the small end of the tooth.

Mr. Jackson said that an ingenious arrangement had been made by Mr. Bodmer, to shape the teeth in bevel-wheels, by means of a long conical cutter, revolving on an axis parallel to the teeth, instead of at right angles to them, and pointing always truly to the apex of the cone of the wheel; the outer end being guided to the required shape of tooth by an enlarged template. Such a cutter might give a pretty correct form to the teeth throughout their length, if the true taper of the sides of the cutter, to the centre of the cone, could be always maintained ; but, in his opinion, there were great practical difficulties in its application.

In answer to an inquiry as to the expense of moulding by the machine, as compared with the ordinary mode of moulding cog-wheels, when there was a pattern already made, Mr. Jackson said there would be little difference; his bevel-wheels, moulded by the machine, were about the ordinary price, and spur-wheels rather under ;—spur-wheels were supplied by him then at about 13*s*., and bevel-wheels at about 17*s*. per cwt. In using the machine, it was unimportant whether the pattern had to be made or not, as the cost of a segment pattern was very small : the smaller sizes were produced for about 3*s*. 6*d*. each, including the cutter.

Mr. Fernie inquired what plan was followed in determining the form of curve for the teeth. He thought the machine appeared one of so much importance, and gave such facility for the correct formation of the pattern, that the advantage of the best theoretical form of tooth might be obtained in all the wheels, without regard to existing patterns.

Mr. Jackson said he made any form of tooth that might be desired, and often had to form a special shape in the case of making a wheel to replace an old one ; the teeth of the new wheel being modified so as to accommodate it in the best manner that was practicable to the actual form of teeth of the fellow wheel with which it had to gear.

The Chairman suggested that the form of teeth recommended by Professor Willis, and so completely worked out by him, might be advantageously adopted,—and the machine certainly gave an important superiority in enabling wheels to be cast with the form of teeth best adapted to the particular purpose for which each wheel was required, without being confined by the limits of ordinary patterns.

Mr. Jackson said, the plan he adopted for the form of the teeth, when left to himself, was one suggested to him by Mr. Bodmer, which was to employ true epicycloid teeth, by cutting wood templates to the curves of the particular circles in each case, and rolling them upon one another—tracing the true curve by a steel point, attached to the one circle upon a tin template fixed upon the other. The true curve for a single tooth was thus obtained without hand-work, or the usual approximation by arcs of circles ; and the steel cutter was then accurately fitted to the

outline traced on the tin template—this being, in fact, the only hand-work in the whole process; the subsequent action of the machine insured a perfect copy of the form of the cutter in every tooth.

Mr. Hawkes thought the machine was very ingeniously contrived, and would certainly produce very accurate work: he wished to know whether the time required for moulding the wheels was longer than by the ordinary process.

Mr. Jackson replied, that the time of moulding was about the same in the case of small wheels: the teeth of a three feet wheel, either spur or bevel, would be moulded in about three hours by the machine. In the case of large wheels, the moulding might be done quicker with an entire pattern than by the machine, by several sets of men being employed at once round the wheel; but in the use of the machine, an important saving of time was found in practice, from the circumstance that the necessity for mending the mould was avoided; which often caused considerable delay in the ordinary moulding, and, however skilfully performed, the repaired part could never be so satisfactory as the rest of the mould.

Mr. Hawkes asked, whether in the case of a large number of wheels, say 100, being ordered from the same pattern, it would be considered preferable to make an entire pattern, or still to mould them with a small segment; and suggested, for such cases, the applicability of a modification of the machine, adapted to draw the whole pattern at once, in a similar manner to the plan adopted with the segment pattern.

Mr. Jackson said, such a case had not occurred at present, as the machine had been mostly employed for making single wheels; but in such a case, a larger segment of the pattern might probably be employed, or even an entire pattern, if the wheel were of moderate size. A machine might doubtless be made to lift any sized pattern, but there would be great difficulties in carrying it out practically; and with the present machine the process of moulding the teeth was so simple and certain that it was effected with great rapidity. The moulding could be done with a segment of a single tooth with equal accuracy, but time would be lost, and the general practice was to have from three to seven teeth in the pattern. The machine had been in operation for eight or nine months, and about 170 spur and bevel wheels had been moulded upon it.

The Chairman inquired what increase of speed was anticipated by Mr. Jackson as practicable in heavy gearing, in consequence of the superior accuracy in the teeth of the wheels moulded by the machine.

Mr. Jackson thought it was very difficult to assign a limit to the speed: if the teeth of the wheels were really accurate, he thought a velocity of 5000 feet per minute might be attained, in the circumference of heavy wheels, with the improved teeth obtained by the machine. He had found very considerable increase of speed practicable in many cases where new wheels, moulded by the machine, were substituted for old ones that had broken. In a rolling mill that he was acquainted with, some of the old wheels had about §-ths inch clearance, and badly-shaped teeth; and when he had put some new wheels, moulded by the machine, into their place, a great difference in the smoothness of the motion was experienced. He was confident the great imperfection in the teeth caused, in some cases, an irregularity to be communicated to the motion, and a serious loss of

power in heavy machinery; and a much higher speed might be safely attained by proper construction of the teeth than was generally considered practicable. He had been much struck by seeing, in a spinning mill, at Alsace, in France, the whole of the self-acting mule spindles, which were running at 4000 revolutions per minute, driven by cog-wheels in place of bands: there was of course a shrill sound in the rooms from so many thousand wheels, but there was no excessive noise such as to prevent the voice being heard. He was convinced, by the examination of that machinery, that accuracy of construction in the teeth was alone wanted to render practicable, with cog-wheels, any speed likely to be required in machinery. These wheels were of iron, cast from metal patterns very carefully made.

The pattern was rapped gently during the time of drawing it up, by striking with a light hammer on a block of wood held upon the top of the pattern. He had anticipated some difficulty from the sand adhering to the pattern, but was surprised to find the clearness with which the pattern drew from the sand.

Mr. Ramsbottom said, he had seen the machine in operation, and there appeared to be no difficulty in drawing the pattern without injury of the mould, on account of the teeth being perfectly parallel and vertical. This correctness arose from the circumstance that the pattern was cut in the same position in which it was moulded, and by means of the same sliding movement that was afterwards made use of to draw it out of the sand; and, consequently, the motion must be absolutely parallel to the face of the pattern. Any inclined position of the slide would cause the pattern to be cut and also drawn from the sand at exactly the same inclination. The action of the machine was certainly very perfect and satisfactory, and it appeared to be very successful in its operation.

The Chairman said, the machine appeared to be a very ingenious and successful improvement in the process of moulding cog-wheels, and of great practical importance.

TWENTY-FIFTH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

Opening remarks on the objects of the Section. By the CHAIRMAN.—It was intended to combine the theoretical and practical parts of the science of mechanics for popular use. It had long been a general prejudice that these two departments were inconsistent with each other, because few persons combined the two. A chair had been established in Glasgow, fifteen years ago, by the Crown, for teaching the theoretic and practical mechanics combined; but even under the professorship of Mr. Lewis Gordon, the attendance was so small, that the chair was discontinued. The prejudice had now to a great extent disappeared. Last session the chair was resumed, and secured a large attendance, who all showed great anxiety to profit by the lectures. A more suitable place could not be found for the discussion of these subjects, than within the walls of a university so closely associated with the name of Watt. Another object of the Section was to take into consideration the laws affecting inventions,

*From the Lond. Athenæum, September, 1855.

and for urging them on the attention of Government, in which it had already been very successful.

Provisional Report on the Strength of Iron Plates. By Mr. FAIRBAIRN.—Mr. Fairbairn stated that he had been unable to complete the experiments under different temperatures, but so far as they had gone they were very satisfactory. Mr. Hopkins had gone far to discover whether it was liquid or solid at the centre of the earth. They had gone so far as a pressure of 104,000 lbs. on the square inch. He hoped to be able to finish the experiments by the next meeting of the Association.

Provisional Report on Boiler Explosions. By Mr. FAIRBAIRN, who said he had not been able as yet to make many experiments, but had a boiler made so as to determine not only the proportionate strength of boilers, but also to offer suggestions for their management. Their boiler was 17 feet in diameter, with two internal tubes, 3 feet in diameter. It had stood a pressure of 80 lbs. on the square inch, but at 100, one of the tubes collapsed. Their object was to discover a means of proportioning the strength of all the parts. It was also desirable to discover something as to the elastic force of steam, and its properties.—In reply to a question, Mr. Fairbairn said he had investigated no less than a dozen explosions, and there was in the press a series of papers, stating, so far as he knew, the causes. Sometimes they arose from gross negligence, but he believed the majority arose from excess of steam; and it was desirable to be able to proportion the strength of all the parts.

Mr. RENNIE having taken the chair,—

On Practical Tables of the Pressure and Latent Heat of Vapors. By the PRESIDENT:—A paper illustrating a new method of drawing up tables for calculating the amount of heat required to expand steam and other vapors so as to fill a given space. The paper was of too technical a character to be given here, but the fundamental formula is, "The latent heat of evaporation of one cubic foot, of a given fluid, at a given temperature, is the product of the absolute temperature by the rate of variation of the pressure with the temperature."

On the Transmission of Time Signals. By Mr. C. P. SMYTH.—Mr. Smyth gave a minute description of the manner in which the time-ball on Nelson's Monument in Edinburgh, and the machinery connected with it, are constructed and managed. He directed attention to a model, which was connected with the wires of the electric telegraph by a wire from the Royal Exchange, erected at the expense of Sir Thomas M'Dougall Brisbane. At five minutes to one, two minutes to one, and at one o'clock, the time was communicated from the Royal Observatory in Edinburgh, and indicated by the model. He said Sir Thomas Brisbane was one of the most earnest promoters of the erection of time-balls at the harbors of Glasgow and Greenock, having on his many voyages been convinced of the imminent peril and numerous shipwrecks which arose from the want of correct chronometers for ascertaining the longitude. It was shown by the Greenwich experiments, that there was no inaccuracy to be apprehended on so short a distance as between Edinburgh and Glasgow.

On Practical Details of the Measurement of Running Waters by Weir

Boards. By Mr. JAMES THOMPSON,—Which would require diagrams to render the explanations intelligible. The principal point made out by Mr. Thompson was the value of a certain form of weir board, and he demonstrated that the edge should be reduced to the thinnest possible degree.

A conversation took place, in which Dr. ROBINSON, of Armagh, Mr. RENNIE, and other gentlemen joined.—At the conclusion, Mr. James Thompson was required to draw out his paper in full, that the facts he had elicited might be available for reference to engineers.

Prof. THOMSON explained the construction of an improved air-pump, the invention of a working man, Mr. James Laing. The principal peculiarity was, dispensing with the valve, two pistons being placed in one cylinder, so as to act as valves to each other.

Report of the Inventors' Fund and Patent Laws Committee. By the EARL OF HARROWBY.

On the Operation of the Patent Laws. By Mr. J. MACQUORN RANKINE.—He said the new patent laws have produced some benefits, as simplifying the means of procuring patents, the division of payments, and the speedy publication of new patents, &c. But he thought the facility with which patents are granted is an objection, as furnishing a means for foolish inventors to take patents under the new law; as also the fact, that as patents are provisionally registered for three months, the public cannot know what the character of a new invention is, and therefore more than one or two persons may take a patent for the same invention. Mr. Rankine pointed out several defects in the law of patents. The scope of the paper was to induce the Section to move for a reform in these laws.

On Artillery and Projectiles. By Mr. W. B. ADAMS.—Mr. WARD read this paper, which gave a description of various kinds of projectiles, and the philosophical reasons why gun-cotton is better for blasting rocks than for gunnery. The first guns in use in all countries were long; but the inconvenience of very long guns was the cause why the length was curtailed, and why also carronades and mortars were invented. The paper then went on to describe the material of which artillery should be made, and the proper mode of manufacture, and an improved trunnion, with some original suggestions regarding the form of wadding and shot best suited to give sure aim and increased velocity and penetration. In giving his idea of the best form of a ball, Mr. Adams thought that the conical form, with feathers, was the best, which is exactly that which Mr. Kennedy, of Kilmarnock, has lately patented, and which has been experimented upon lately at Ardrossan and Troon. The idea of an elongated ball, which should also be charged like a bomb, has also been anticipated by Mr. Kennedy. Welded guns, united by hydrostatic pressure,—the coating inside with another metal to prevent abrasion,—and several other improvements, which have in part been adopted by inventors, were also recommended.

Dr. ROBINSON was of opinion that feathers upon a ball was a mistaken idea, because the ball carries with it a portion of air, and that rotation could not be secured to the ball by feathers, alone, as they could not act but on the body of air which they carried with them. Rifled guns are

more liable to burst, because the force necessary to explode a ball from such a piece of ordnance, is much greater than that required for a plain bored gun; and also that a rifled gun is much more liable to burst or be rendered useless from frequent discharges, because of the force necessary to cause rotation having to be added to that which causes projection. Dr. Robinson alluded to the bronze guns of the Dardanelles, which are of three feet bore, used against our fleets not many years since, and which were made by Mohammed II., and asked whether bronze might not now be used instead of cast iron. He suggested the probability that on experiment, railway iron might be found better than cast iron for ordnance.

Mr. Fairbairn said the material of which guns were made was not so good as it was fifty years ago. He was present at Woolwich this week, and saw the practice of the guns there. One of them seemed properly moulded in every part; but it was found that the welding in one part was not sound, and the gas getting into the fracture operated just like a wedge, and split it as if it had been made of paper. Another was formed of steel bars, with a breech of cast iron attached to it. The breech was entirely blown off the gun, and the bars torn asunder. It appeared to him absolutely necessary to have such a material as would not only resist the severe impulse which the discharge of the shot caused, but be perfectly solid in the mass. If they were made of parts, such as the staves of a cask, these opened, and the result was the fracture of the gun. The Stirling gun was a mixture of wrought with cast-iron, and it certainly carried one-fourth or one-fifth more of common pressure, but when applied to artillery under Colonel Dundas, after a few rounds the pieces were burst. The mode of casting these large guns is also defective. They were generally cast solid, and in the cooling the metal was left exceedingly porous in the centre, and when one began to bore out the gun, one found it was not of so close a texture inside as out. Now they took the precaution of having cores in the middle, through which they sent a current of cold water to cool the inside simultaneously.—Dr. Robinson: About a century ago they cast them hollow, and it was thought a great improvement to cast them solid.—Mr. Fairbairn believed if they went about the work more carefully, they would arrive at a safer and better mode of casting than at present. If the mortars were made a foot longer, he believed, instead of sixty pounds, fifty pounds of powder would carry a shell of the same weight, and to a greater distance, and with greater accuracy. He thought, in the mortars, a great quantity of the metal was in the wrong place, in a great many cases. They had the same thickness of metal at the mouth as at the breech, whereas it might taper without any danger, the pressure being less at the mouth. He explained an ingenious ball, in which there was a spiral tube, so that the ball with an ordinary gun suited all the purposes of a rifle; but he did not know whether the experiment was successful or not. Till lately, guns of the ordinary calibre would stand 600 or 700 rounds before they were injured, but they always gave away at the vent. But they got into a plan of putting a tube into the vent, which made them stand 600 or 700 rounds more. Now-a-days the same guns would not stand 100 rounds; perhaps the reason was that the metal was not properly selected. He

believed the subject was now before the authorities at Woolwich of what caused the explosion at Sweaborg,—and he hoped it would lead to better material, or a better selection. The iron procured by hot blast is excellent for machinery purposes; but he did not think it the best for artillery. With regard to the Turkish artillery, he was at Constantinople some years ago, and they are almost all made of a mixture of brass and tin. Mr. Mare, at Blackwall, is now constructing a gun three feet in diameter—the breech of cast iron and the tube of direction of wrought iron. Whether it would answer or not, he did not know.—Dr. Robinson: The bronze guns failed in a very remarkable manner. The ball rises on firing, is deflected on the gun, and if the gun is long it is again deflected, and deep holes are made in the barrel owing to the softness of the metal. Could not a thin lining of steel or wrought iron be inserted into the tube?—Mr. Fairbairn thought it was very difficult to form any gun that differed in its parts. He would prefer to have a gun perfectly solid—of steel, if they pleased; for he had seen excellent specimens of steel manufactures from Prussia in the Great Exhibition, and well calculated for making field artillery. The artillery of the present time was much larger than in former times, and allowance must be made for that. The Government was endeavoring at present to get charcoal iron from Nova Scotia, and there were large supplies of wood and iron in the Bay of Fundy.—Mr. Lawrie proposed to have no vent at all, but to fire in the manner in which rocks are blasted, by means of galvanism. This would prevent wearing at the vent. He hoped artillery would be brought to perfection, for as weapons had improved, war had decreased in brutality; and he hoped there would be a good stand up fight for it, in order that they might have a lasting peace.—A Member stated that some hydrostatic presses had been made of cast iron with a case of wrought iron, at Mr. Downie's works here, and had stood an immense pressure, but they had not as yet tried it on guns.—Mr. Fairbairn asked if the gun made at Mr. Downie's had been cast in such a way as to cause an amalgamation of the cast and wrought iron? If that were the case, he had no doubt it would secure great strength. He had a doubt, however, that there was a difference of ductility which would cause separation. It had occurred to him that they might be cast under extreme hydrostatic pressure. They had cast them at Woolwich with 19 feet of iron on the gun, but he did not as yet know the result.—Mr. Sykes Ward thought a gun could not explode so readily if the powder did not impinge directly on the ball.

On certain Curious Motions observable on the Surfaces of Wine and other Alcoholic Liquors. By Mr. J. Thomson.—The phenomena of capillary attraction in liquids are accounted for according to the generally received theory of Dr. Young, by the existence of forces equivalent to a tension of the surface of the liquid, uniform in all directions, and independent of the form of the surface. The tensile force is not the same in different liquids. Thus it is found to be much less in alcohol than in water. This fact affords an explanation of several very curious motions observable, under various circumstances, at the surface of alcoholic liquors. One part of these phenomena is that if, in the middle of the surface of a glass of water, a small quantity of alcohol, or strong spirituous liquor, be gently introduced, a rapid rushing of the surface is found to occur

outwards from the place where the spirit is introduced. It is made more apparent if fine powder be dusted on the surface of the water. Another part of the phenomena is, that if the sides of the vessel be wet with water above the general level surface of the water, and if the spirit be introduced in sufficient quantity in the middle of the vessel, or if it be introduced near the side, the fluid is even seen to ascend the inside of the glass until it accumulates in some places to such an extent that its weight preponderates, and it falls down again. The manner in which Mr. Thomson explains these two parts of the phenomena is, that the more watery portions of the entire surface, having more tension than those which are more alcoholic, drag the latter briskly away, sometimes even so as to form a horizontal ring of liquid high up round the interior of the vessel, and thicker than that by which the interior of the vessel was wet. Then the tendency is for the various parts of this ring or line to run together to those parts which happen to be most watery, and so that there is no stable equilibrium, for the parts to which the various portions of the liquid aggregate themselves soon become too heavy to be sustained, and so they fall down. The same mode of explanation, when carried a step further, shows the reason of the curious motions commonly observed in the film of wine adhering to the inside of a wine-glass, when the glass having been partially filled with wine, has been shaken so as to wet the inside above the general level of the surface of the liquid; for, to explain these motions, it is only necessary further to bring under consideration that the thin film adhering to the inside of the glass must very quickly become more watery than the rest, on account of the evaporation of the alcohol contained in it being more rapid than the evaporation of the water. On this matter, Mr. Thomson exhibited to the Section a very decisive experiment. He showed that in a vial partly filled with wine, no motion, of the kind described, occurs as long as the vial is kept corked. On his removing the cork, however, and withdrawing, by a tube, the air saturated with vapor of the wine, so that it was replaced by fresh air capable of producing evaporation, a liquid film was instantly seen as a horizontal ring creeping up the interior of the vial, with thick-looking pendant streams descending from it like a fringe from a curtain. He gave another striking illustration by pouring water on a flat silver tray, previously carefully cleaned from any film which could hinder the water from thoroughly wetting the surface. The water was about one-tenth of an inch deep. Then, on a little alcohol being laid down in the middle of the tray, the water immediately rushed away from the middle, leaving a deep hollow there, which laid the tray bare of all liquid, except an exceedingly thin film. These and other experiments, which he made with fine lycopodium powder dusted on the surface of the water, into the middle of which he introduced alcohol gently from a fine tube, were very simple, and can easily be repeated. Certain curious return currents which he showed by means of the powder on the surface, he stated he had not yet been able fully to explain. He referred to very interesting phenomena previously observed by Mr. Varley, and described in the fiftieth volume of the Transactions of the Society of Arts, which he believed would prove to be explicable according to the principles he had now proposed.

On the Binocular Vision of Surfaces of different Colors. By Sir DAVID BREWSTER.—Prof. Dove had published an account of some beautiful experiments in connexion with this subject some years ago. M. Dove showed in his paper that when different colors at the same real distance are regarded by the eye they appear to be at different distances; this is also the case when a white surface is compared with a black. Now M. Dove argues if a white surface and a black one be stereoscopically combined, one of them must be seen through the other. Taking a figure for the left eye with a white ground, and a second figure of the same object on a black ground for the right eye, when these two figures are combined, a beautiful effect is observed: the figure starts into relief, and its sides appear to possess a shining metallic lustre. This is the case when the surface of each single object is quite dull and lustreless. On this experiment M. Dove founds a theory of lustre, supposing it to be produced by the action of light received from surfaces at different distances from the eye. An example of this is the effect observed on looking at varnished pictures: one portion of the light comes from the anterior surface of the varnish, and the other from its posterior surface, the action of both of these conspiring to produce the observed lustre. The metallic lustre of mica is also referred to by M. Dove as an example of the same kind. In his present communication, Sir David Brewster controverts the theory here laid down, and bases his objections on the following remarkable experiment:—where a white surface without definite boundary and a black surface of the same kind are regarded through the stereoscope no lustre is observed. Sir David therefore infers, that the lustre is due not to the rays from one surface passing through the other to the eye, but to the effort of the eyes to combine the two stereoscopic pictures.

Experimental Demonstration of the Polarity of Diamagnetic Bodies. By Prof. TYNDALL.—The author referred to the Bakerian Lecture of the present year as proving that a bar of bismuth freely suspended within a spiral of copper wire, excited by a current passing through that wire and acted upon by external magnets, could be attracted and repelled with the same certainty as, though with far less energy than, a bar of iron,—the sense of the deflection, which indicated the polarity of the diamagnetic bismuth bar, being always opposed to the deflection of the iron bar under the same circumstances. The experiments now described formed the complement, so to speak, of those described in the lecture referred to. In the latter case the bismuth bar is deflected by magnets, but as the action is mutual, it is to be expected that the magnets, if properly arranged, could be deflected by the diamagnetic bars. An experiment of this nature has already been made by Prof. Weber, of Gottingen, but the results obtained by this distinguished experimenter have not commanded general conviction; they have been denied and criticized by Matteucci and others. Prof Tyndall has to thank M. Weber for the plan of an instrument, constructed by M. Leyser, of Leipsic, which has enabled him to remove the last trace of doubt from this important question. The instrument consists essentially of two upright spirals of copper wire about eighteen inches long, fastened to a stout slab of wood, enclosed on all sides during the time of experiment, and so fixed into solid

masonry that the spirals were vertical. Above the spirals is a wooden wheel with a grooved circumference; below the spirals there was a similar wheel; an endless string passed tightly around both wheels, and to this string was attached two cylinders of the diamagnetic body to be examined. By turning the lower wheel by a suitable key, the cylinders may be moved up and down within the spirals. Two steel bar magnets are arranged to an astatic system, connected together by a rigid brass junction, and suspended so that both magnets are in the same horizontal plane. It is so arranged that these two magnets have the two spirals between them, and have their poles opposite to the centre of the spirals. When, therefore, a current is sent through the spirals, it exerts no more action on the magnets than the centre or neutral point of a magnet would do. Supposing the bars within the spirals to be also perfectly central, they also present their neutral points to the magnetic poles, and hence exert no action upon it. But if the key be turned so as to bring the two *ends* of the diamagnetic bars to act upon the suspended magnets, if the bars be polar, the magnitude and nature of their polarity will be indicated by the consequent deflection of the magnets. The index by which the deflection of the magnets is observed, is a ray of light deflected from a mirror attached to the magnets; and as the length of this ray may be varied at pleasure, the sensibility of the instrument may be indefinitely increased. When cylinders of bismuth are submitted to experiment, a very marked deflection is produced, indicating a polarity on the part of the bismuth to the polarity of iron. This is the result already obtained by M. Weber; but against it, it has been urged that the deflection is due to induced currents excited in the metallic cylinders during their motion within the spirals. To this objection Prof. Tyndall replied as follows: —first, the deflection produced was a *permanent* deflection, which could not be the case if it were due to the momentary currents of induction; —secondly, if due to induction, copper ought to show the effect far more energetically than bismuth, for its conducting power and, consequently, the facility with which such currents are produced, is at least fifty times greater than that of bismuth. But with cylinders of copper no sensible deflection was produced;—thirdly, two prisms of the heavy glass with which Mr. Faraday discovered the diamagnetic force and produced the rotation of the plane of polarization of a luminous ray were substituted for the metallic cylinders; and although the action was far less energetic, it was equally certain as in the case of bismuth, and indicated the same polarity. The formation of induced currents is wholly out of the question here, for the substance is an insulator. The experiments, therefore, remove the last remaining doubt from the position that diamagnetic bodies under magnetic excitement possess a polarity which is the reverse of that possessed by magnetic ones. Prof. Tyndall, in referring to his labors on this subject, and to the beautiful and costly apparatus by which these results have been obtained, observed that it was the funds placed at his disposal by the Council of the Royal Society, which enabled him to obtain these results; and this may be taken as an example of the manner in which the annual Government grant is applied to the promotion of scientific research and discovery.

On certain Anomalies presented by the Binary Star, 70 Ophiuchi. By Capt. W. S. Jacob.—This pair has been long known to astronomers as a binary system, but the exact orbit is yet in doubt, although nearly a whole revolution has been completed since it was first observed by Sir W. Herschel, in 1779. All the orbits that have been computed fail at certain points in representing the observed positions, and those which best represent the angles fail entirely as regards the distances. The most remarkable point is, that even in those orbits which agree best with observation, the errors in the angles assume a *periodical* form, retaining the same sign through a considerable space of time. An orbit has been computed with a period of 93 years, in which the errors are + from 1820 to 1823,—with one exception from 1823 to 1830, doubtful in 1830 to 1832, and from 1833 to 1842 all +, after which they continue for the most part —. This sort of error must depend upon some law; it *might* arise from a change in the law of gravitation, but may be accounted for more simply by supposing the existence of a third opaque body perturbing the other two. Such bodies have already been suggested to account for irregular motions of apparently single stars, such as Sirius and Procyon. The body in this case, if supposed to circulate as a planet round the smaller star, need not be very large, as the deviation from the ellipse does not exceed about 0″·1. Assuming the small star to describe a secondary ellipse in which $a = 0''{\cdot}08$, $\epsilon = 0''{\cdot}15$ and $\omega = 200°$, and applying corresponding corrections to the computed positions, the average errors in the angles is reduced from 50′ to 37′, and in the distances measured subsequent to 1837, from 0″·14 to 0″·11, or by about $\frac{1}{4}$; while the maximum errors are also reduced in about the same proportion. There is, therefore, *prima facie* evidence for the existence of such a body, and it is desirable that the fact should be still further tested by careful observation. The subject possesses an additional interest at the present time, in reference to the opinion brought forward in the Essay "*Of the Plurality of Worlds*," on the *impossibility* of double stars having attendant planets.

On the Aurora Borealis. By Admiral Sir John Ross.—The communication I had the the honor of making to the British Association for the Advancement of Science at Belfast, on the interesting subject of the aurora borealis, was verbal, and, therefore, not entitled to a notice in the Association's valuable *Transactions* of that period; but, having subsequently repeated the experiments I then verbally mentioned, I can now confidently lay the account of them before the public, trusting that when taken into consideration, they will be found corroborative of the theory which I published in the year 1819, and which led to a controversy that shall be hereafter mentioned. It having occurred to me that, if my theory was true, namely, "that the phenomena of the aurora borealis were occasioned by the action of the sun, when below the pole, on the surrounding masses of colored ice, by its rays being reflected from the points of incidence to clouds above the pole which were before invisible," the phenomena might be artificially produced; to accomplish this, I placed a powerful lamp to represent the sun, having a lens, at the focal distance of which I placed a rectified terrestrial globe, on which bruised glass, of the various colors we have seen in Baffin's Bay, was placed, to

represent the colored icebergs we had seen in that locality, while the space between Greenland and Spitzbergen was left blank, to represent the sea. To represent the clouds above the pole, which were to receive the refracted rays, I applied a hot iron to a sponge; and, by giving the globe a regular diurnal motion, I produced the phenomena vulgarly called "The Merry Dancers," and every other appearance, exactly as seen in the natural sky, while it disappeared as the globe turned, as being the part representing the sea to the points of incidence. In corroboration of my theory, I have to remark that, during my last voyage to the Arctic Regions (1850-51), we never, among the numerous icebergs, saw any that were colored, but all were a yellowish white; and, during the following winter, the aurora was exactly the same color; and, when that part of the globe was covered with bruised glass of that color, the phenomena produced in my experiment was the same, as was, also, the Aurora Australis, in the Antarctic regions, where no colored icebergs were ever seen. The controversy to which I have alluded was between the celebrated Prof. Schumacher, of Altona, who supported my theory, and the no less distinguished M. Arago, who, having opposed it, sent M. G. Martens and another to Hammerfest on purpose to observe the aurora, and decide the question. I saw them at Stockholm on their return, when they told me their observations tended to confirm my theory; but their report being unfavorable to the expectations of M. Arago, it was never published; neither was the correspondence between the two Professors, owing to the lamented death of Prof. Schumacher. I regret that it is out of my power to exhibit the experiments I have described, owing to the peculiar manner in which the room must be darkened, even if I had the necessary apparatus with me; but it is an experiment so simple that it can easily be accomplished by any person interested in the beautiful phenomena of the aurora borealis.

On Hail Storms in India from 1851 *to* 1855. By Dr. Buist, was read by Col. Sykes.

On the Establishment of a Magnetic, Meteorological, and Astronomical Observatory on the Mountain of Augustus Mullay, at 6200 *feet, in Travancore.* By Astronomer Broun.—Astronomer Broun, in a letter to Col. Sykes, dated 2d July, 1855, describes the successful establishment of an observatory on Augustus Mullay, at 6200 feet above the sea level, for the purpose of simultaneous record with the observatory at Trevandrum. The difficulties of access to the summit of the mountain were so great, from having to cut paths through dense jungles, infested by elephants and other wild animals,—from having to use ropes and mechanical aid in getting up the building materials, provisions, and the instruments,—and in the delays from the laborers running away from fright and the effects of cold,—that two years were consumed in the undertaking. The object of Astronomer Broun in making known his successful efforts in Europe, is to enable observers to put themselves into communication with him, in case they should desire to have any experimental researches made on so novel a position for an observatory.

On the Detection and Measurement of Atmospheric Electricity by the Photo-Barograph and Thermograph. By Mr. M. J. Johnson.—Photography has already rendered considerable aid to science, and some results

brought before the Section by Mr. Johnson, *Radcliffe Observer*, Oxford, furnish an example of this. On examining and comparing the registrations of the thermometer and barometer certain peculiarities presented themselves, which indicate a curious connexion between the course of these instruments and the state of the weather. The line which indicates this course is sometimes serrated, sometimes even and continuous; and these appearances correspond to certain determinate states of the weather. The most remarkable result is a sudden change of the height of the barometric column, which takes place simultaneously with the occurrence of a peal of thunder:—a contemporaneous effect was produced upon the thermometer. It is to be hoped that Mr. Johnson will continue his observations, so as to place the connexion, which he seems to have detected, beyond all doubt.

For the Journal of the Franklin Institute.

Particulars of the Steam Barge Franklin.

Hull built by Reed, of Boundbrook. Machinery by Reaney, Neafie & Co., Philadelphia, Pa. Intended service, freighting between Albany, Philadelphia, and Baltimore.

HULL.—

Length on deck,		105 feet.
Breadth of beam,		23 "
Depth of hold,		8 "
Length of engine space,		25 "
Contents of bunkers in tons of coal,	10.	
Mast,	1 for hoisting cargo.	

ENGINE—One—inverted cylinder—direct acting.—

Diameter of cylinder,		26 inches.
Length of stroke,		2 feet 1 "
Maximum pressure of steam in pounds,	60.	
Cut-off from commencement of stroke,		12½ "

BOILER—One—flue and return flue.—

Length of boiler,		16 feet 6 inches
Breadth "		7 " 3 "
Height " exclusive of steam drum,		7 "
Cubic feet "	60.	
Number of furnaces,	2.	
Breadth "		3 "
Length of grate bars,		5 "
Number of flues or tubes,	14.	
Internal diameter of flues or tubes,		6¼ "
Length of flues or tubes,		11 "
Heating surface,		560 sq. feet.
Diameter of smoke pipe,		2 feet 4 "
Height "		24 "

SCREW PROPELLER.—

Diameter,		7 feet 6 inches.
Length of screw,		2 " 3 "
Pitch "		13 " 6 "
Number of blades,	4.	

W. J.

For the Journal of the Franklin Institute.

Particulars of a Tug Boat for Lake Ontario.

Hull built by Dobbin & Mainwaring, Oswego. Machinery by Reaney, Neafie & Co., Philadelphia, Pa. Intended service, towing on Oswego River and Lake Ontario.

HULL.—		
Length on deck,	100 feet.	
Breadth of beam,	18 "	
Depth of hold,	9 "	
Length of engine space,	32 "	
Draft, estimated forward,	7 "	
" aft,	8 "	
ENGINES—Two—inverted cylinder—direct acting.—		
Diameter of cylinder,		20 inches.
Length of stroke,	1 foot	8 "
Maximum pressure of steam in pounds,	60.	
Cut-off from commencement of stroke,		10 "
BOILER—One—flue and return flue.—		
Length of boiler,	20 feet.	
Breadth "	7 "	
Height " exclusive of steam drum,	8 "	3 inches.
Number of furnaces,	2.	
Breadth "	2 "	9 "
Length of grate bars,	5 "	
SCREW PROPELLER.—		
Diameter of screw,	8 feet.	
Length "	2 "	5 inches.
Pitch "	12 "	9 "
Number of blades,	4.	
Average revolutions per minute, estimated,	70.	

Remarks.—Cabins and engine room below deck.

The boiler is being constructed at Oswego, and is of sufficient size to furnish an abundance of steam when the engines are required to work whole stroke, in order to make way against the violent and sudden storms that occur on the lakes. W. J.

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*Failure of the Nasmyth Gun.**

The alleged failure of the Nasmyth Gun has called the attention of scientific men to the changes which iron undergoes by use, and to the causes which accelerate its passage from the fibrous to the crystalline state. Dr. Noad, during a visit to the Welsh iron mines, has tried some experiments, and communicated the results obtained to the public,—results of deep interest, considering how extensively iron is now used for bridges, cables, and supports. Dr. Noad says:—"The tendency of iron to pass from the fibrous or tough to the crystalline or brittle condition is promoted by various causes; every thing, in fact, which occasions a vibration among its particles has this tendency."—He then describes his experiments, which prove that the metal may be made to pass from one

* From the London Athenæum, September, 1855.

state to the other:—"Seeing a large quantity of iron chain lying about, and learning that, though scarcely worn, it had been laid aside in consequence of the breaking of some of the links, I examined several from different parts of the chain. I found that a single smart blow with a hammer was sufficient to snap the metal, the fracture of which was crystalline, and its brittleness such that it could, without difficulty, be broken into small pieces under the hammer. I now heated strongly in a forge some of the broken links, and allowed them to cool very slowly underneath a bed of fine sand. After the lapse of twenty-four hours they were examined; the metal was found to have recovered its tenacity, it could no longer be broken to pieces under the hammer; and when at length, after repeated heavy blows, it did partially yield, the texture of the metal was found to be perfectly fibrous—every trace of a crystalline structure had disappeared."—Dr. Noad thinks that the iron of the Nasmyth Gun has been crystallized by continuous hammering; and he suggests that its fibrous condition may be restored by annealing. But this is scarcely the most interesting question raised. How about the iron bridges? Are they passing into that crystalline condition in which they will be as strong as glass—and no stronger? How, again, about our chain cables? Are our leviathans of the deep floating in a fanciful security, trusting to iron ropes that will snap as a child's thread in the day of storms?

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*History and Properties of Aluminium.**

A fine bar of aluminium is now on view at the Polytechnic Institution, where Mr. Pepper explains its history and properties. This metal was discovered by Sir H. Davy in 1808. Oersted endeavored to exhibit the metal in a detached form by the employment of chloride of aluminium, and about thirty years ago Wöhler succeeded in obtaining a few grains of it. It has been reserved, however, for M. St. Clair Deville to produce (in the private laboratory of the Emperor of France) a whole bar of aluminium, which has been presented to Mr. Pepper by the Emperor. After giving a brief history of the metal, the non-success of experiments for obtaining it, and the "sodium" and "voltaic battery" processes, Mr. Pepper describes its nature and properties. "Aluminium" is classed by M. Deville as an "unalterable" metal, intermediate between the precious and the more common metals. Mr. Fownes includes it in the same category as glucinum, yttrium, cerium, lanthanium, didymium, zirconium, and thorinum—all of them "metals of the earth proper." The specific gravity of aluminium is 2·56 (or 2·60 according to Mr. Fownes, water being taken as unity). This is about one-eighth of the gravity of platinum, and one-third that of iron, platinum being 20·98; gold, 19·26; mercury, 13·57; silver, 10·47; iron, 7·79; zinc, 6·5; and titanium (next above aluminium), 5·30. The equivalent of aluminium is 13·69, The metal is beautifully white, with a slight blueish tinge, and reflects light clearly. It is malleable and ductile, almost without limit; when passed through the fingers it exhales a slight odor of iron. It is a perfect conductor of electricity,—the best known among the metals,

* From the Lond. Athenæum, August, 1855.

—and is negative to zinc. It melts at a rather higher temperature than zinc, and is excessively fusible. The chemical properties of aluminium are invaluable. It resists oxygen,—water has no action upon it at any temperature,—and even sulphuretted hydrogen—that great defacer of the brightness of metals in large towns—exercises no destructive influence upon it. It is now, moreover, ascertained that the metal does not decompose water. Thus aluminium bids fair to become one of the most useful and serviceable of the metals, and from it have already been manufactured some medals and watch-wheels of exquisite workmanship.—Under Mr. Pepper's active management, the Polytechnic is perpetually adding to its attractions. Some of his experiments with Thames water are particularly interesting just now.

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*Notice of the Launch of the Cunard Steamer "Persia."**

On the 3d of July, the steamship *Persia*, the first iron paddle-wheel liner, built by the orders of the Messrs. Burns, of Glasgow, for the Cunard, or British and North American Steam Company, was launched from the building-yard of Messrs. Robert Napier and Sons, at Govan. Messrs. Napier are the builders both of the hull and the engines. The *Persia* is the largest steamer both in capacity of hull and steam power which has yet been built. The *Persia* far exceeds in length, strength, tonnage, and steam power the *Great Britain* or the *Himalaya*, and exceeds also by no less than 1200 tons the internal capacity of the largest of the present Cunard liners. Her chief proportions are these:—Length from figure-head to taffrail, 390 feet; length in the water, 360 feet; breadth of the hull, 45 feet; breadth over all, 71 feet; depth, 32 feet; burden 3600 tons. According to the strict government rule of admeasurement, her power is equal to that of 900 horses; according to the plan laid down in Earl Hardwicke's bill, her power is equal to that of 1200 horses. The *Persia* has seven water-tight compartments. The goods are to be stowed in two of these divisions, each about 90 feet long, by 16 in breadth, and 20 feet in height. These goods stores, or rather tanks, are placed in the centre line of the ship, with the coal cellars or bunkers on each side of them. At the same time the vessel is so constructed as to have a double bottom under these goods chambers, so that if the outer were beat in or injured, the inner would, in all likelihood, protect them dry and intact. She has separate sleeping accommodations for nearly 300 passengers, disposed along what may be called the main deck, lying immediately above the goods and coal stores. There are in the forward part of the ship about 210 berths for the sailing crew, firemen, and stokers.

Simple mode of Cutting Stone.†

Among the French machinery will be found a very ingenious and simple mode of cutting stone, exhibited by a man named Chevaliere. He causes a wire to run at a high velocity over the surface which he wishes to bisect, and by dropping on it a mixture of sand and water the oper-

* From the Lond. Civ. Eng. and Arch. Jour., August, 1855.

† From the London Mining Journal, No. 1047.

ation is rapidly completed. The hardest granites yield so quickly to this process, that the inventor can with one-horse power separate it at the rate of a square foot per hour, the wire running at the rate of 40 ft. per second. Using the ordinary saw, the same amount of work would require three-horse power, and would expend 15 frs. worth of material, instead of 1 fr., which is all that the wire costs.

Remarks on the Smoke Question. By C. W. Williams.*

To the Editor of the Mechanics' Magazine.

Sir.—In your number of this day, page 612, under the head of "The Smoke Question," you have given an abstract of the "Conclusions deduced from the Evidence obtained by the General Board of Health," and now printed by order of Parliament. As these "conclusions" contain not only many useful remarks, but also many inaccuracies and errors, by which the public may be led astray, I propose submitting, through your columns, some observations on each, and by which they will become more intelligible, and at the same time remove those misapprehensions which have, no doubt inadvertently, been introduced.

Conclusion 1. "That the emission of smoke is the effect, and may be taken as the proof of *imperfect combustion*, and is therefore always attended with waste of fuel."

This conclusion is too general to be practically useful. It leaves the main question untouched, and the main issue undecided, namely: What is imperfect combustion, and what is the combustible that is *imperfectly consumed?* Until these are determined, the means of counteracting this imperfection must be equally undetermined. Now, imperfect combustion has not reference to the coal employed, but to the gaseous portion of it, generated in the furnace, and arises from two causes; first, the allowing a portion of the carbon of the gas to pass away, unburnt, by allowing it to be reduced in temperature below that required for its ignition, and before it had obtained atomic contact with the oxygen of the air; secondly, from another portion of the carbon being allowed to pass away, unconsumed, in the form of invisible carbonic oxide. The remedy in both cases lies in bringing the air, either to the carbon or the oxide, not in a body, but in such a *divided form* as to enable it instantaneously to effect the required mixture, and atomic contact, which is the *sine qua non* of subsequent combustion.

Conclusion 2. "That the fuel wasted is not only the visible smoke, which is *unburnt carbon*, but generally a far larger portion in the form of gas, both common coal gas and that called carbonic oxide, which is only *half-burnt carbon*, and which therefore has not produced the heat which it would have generated if it had been perfectly consumed.

This is incorrect in several respects. Visible smoke is not "*unburnt carbon.*" Smoke is a compound of large cloud-like volumes of carbonic acid, nitrogen, and steam (the latter from the combustion of the hydrogen of the gas). With these three are mixed more or less of unburnt

* From the Mechanics' Magazine, July, 1855.

carbon, but relatively in such a small proportion that although it gives the cloudy volumes their blackened color, is nevertheless, comparatively, so insignificant in weight or value, as to be, commercially, unworthy of notice as a combustible, were it possible, which it is not, to effect its combustion, diffused as it necessarily must be in those cloudy masses.

Again—carbonic oxide is not "half-burnt carbon." There is, in fact, no such thing as half-burnt carbon. An atom of carbon must be either burnt or unburnt. Carbonic oxide is a distinct, well-defined gas. It is formed in the furnace, not from the coal, but from the coke portion of the coal, when in an incandescent state. Carbonic acid, formed from one portion of such incandescent, or red-hot fuel passing up through the portion above it, takes up an additional equivalent of carbon. Thus, one volume of carbonic acid is formed into two volumes of carbonic oxide. Its combustion, when the air is admitted, is easily distinguished in the furnace by its semi-transparent bluish color, and may be perceived in the fire-box of the locomotive when the door is opened.

Conclusion 3. "That the chief impediment to the prevention of smoke in manufactories is the *insufficient boiler surface* in proportion to the steam required; a deficiency which causes waste in two ways; first, because much of the heat produced escapes up the chimney uselessly, and next, because this deficiency has to be made up by *over-firing*, whence imperfect combustion and consequent waste of fuel."

This conclusion is erroneous and misleading. The prevention of smoke has no relation to the "insufficient boiler surface." This is shown by the fact that smoke is formed in the same way and to the same extent where there is neither boiler nor boiler surface; as in many furnaces used in manufactories; for instance, in the charcoal heating furnaces of the sugar refiners, or those used for heating the iron plates of boiler makers and iron ship builders. The generation of the heat in the furnace and the generation of steam in the boiler are distinct processes, and the confounding the one with the other is a serious mistake, and tends to lead boiler makers and engineers astray. What is called "*over-firing*," is but effecting a more rapid combustion, as when we stir the fuel in a house grate. If the fuel be more rapidly consumed in the furnace, there must necessarily be more gas generated in equal time, and, of course, more air is required for such increased quantity of gas. It is the overlooking of the necessity for this increased quantity of air which leads engineers into this error.

Conclusion 4. "The employers of furnaces labor under great difficulty as to the best and most economical use of fuel, because ordinary makers of furnaces seem to be guided in their construction by little better than empirical rules, instead of acting upon well established scientific principles, or the results of accurate experiments."

This conclusion is too well founded to require any comment.

Conclusion 5. "That notwithstanding this great difficulty, many persons have succeeded in entirely preventing the escape [formation] of visible smoke, except while first lighting their furnaces, and many others have reduced the time during which smoke is emitted to a fraction of its former amount."

This is also unquestonably true.

Conclusion 6. "That experience has fully proved that there is no truth in the common allegation, that if smoke be prevented, there must be increased difficulty in getting up and maintaining steam."

This is also true, provided the combustion in the furnace and the prevention of the formation of smoke be properly effected by the introduction of the *required quantity* of air, in the *proper manner*. If, however, the air be injudiciously introduced, though smoke may be prevented, nevertheless there may be "increased difficulty in getting and maintaining steam."

Liverpool, June 30, 1855.

(To be Continued.)

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*Statistics of Copper and Zinc.**

A return obtained by Mr. M. Williams, M. P., shows that the total quantity of copper imported into the United Kingdom in 1854, amounted to 50,940 tons of ore, 6351 tons of regulus, 1597 tons of unwrought copper, 1621 tons of partly-wrought copper, 710 tons of plates and coin, and 638 tons of manufactures. The total quantity of British copper exported in 1854, amounted to 13,678 tons (exclusive of ore). The total quantity of British copper exported from the port of London in 1854, amounted to 5434 tons, and from Liverpool, 5920 tons. The quantity of zinc or spelter imported into the kingdom in 1854, was 19,588 tons, and 336 tons of oxide of zinc, while the quantity of British and foreign zinc or spelter exported, was respectively 3030 and 5322 tons.

Mineral Statistics of Great Britain.†

From 2397 collieries enumerated in the United Kingdom, 64,661,401 tons were raised, worth nearly 15,000,000*l.*, or nearly 9,000,000 tons above the quantity stated in the highest figures previously quoted,—those of Mr. T. Y. Hall. Of tin, the annual produce is stated at 5763 tons, which, at from 112*l.* to 118*l.* a ton, would be worth nearly 700,000*l.* Of copper, 13,000 tons were produced in 1854, worth about 1,229,000*l.*; of lead 64,000 tons; and of silver, 700,000 ounces. Of pig-iron, the produce was 3,069,838 tons, valued at 9,500,000*l.* Mr. Hunt has ascertained that more than 300,000 persons are employed in mining operations in Great Britain,—nearly one-third of them being males under twenty, while nearly 9000 are females, and of these the larger proportion under twenty years of age.

Aberdeen Railway Accident.‡

We copy the following in the hopes that it may be found useful to our Courts, and Railroad officials. *Ed. Journ. F. I.*

Wm. Joss, station-master at the Cove station, and Andrew Symon, a porter, who were tried at the Circuit court of Justiciary at Aberdeen, for the late accident on the above line, in consequence of which Ensign Dobie had both his legs fractured, and other passengers were injured,

* From the Lond. Builder, No. 649.

† From the Lond. Athenæum, September, 1855.

‡ From Herapath's Journal, October 6, 1855.

were sentenced to three months imprisonment by Lords Cowan and Handyside, accompanied with some severe observation, notwithstanding the jury strongly recommended them to mercy on account of previous good conduct. Severity, we are convinced, is the only way to cure negligence, and is the best of kindness to railway servants.

For the Journal of the Franklin Institute.

Particulars of the Steamer America.

Hull built by Wm. H. Webb, New York. Machinery by Novelty Iron Works, New York. Intended service, Pacific Ocean.

HULL.—

Length on deck, from fore part of stem to after part of stern post above spar deck,	170 feet.	
Breadth of beam at midship section,	27 "	8 inches.
" " to spar deck,	12 "	
Draft of water at load line,	8 "	6 "
" " below pressure and revolution,	8 "	6 "
Tonnage, (custom house.) 650.		
Area of immersed midship section at this draft,	205 sq. feet.	
Contents of bunkers in tons of coal, 225.		
Masts and rig, Brigantine.		

ENGINES.—Oscillating.

Diameter of cylinders,		45 inches.
Length of stroke,	5 feet.	
Maximum pressure of steam in pounds, 25.		
Cut-off at $\frac{1}{4}$.		
Maximum revolutions per minute, 20.		
Weight of engines, 75 tons.		

BOILERS.—Two—return flued.

Length of boilers,	21 feet.	
Breadth "	9 "	6 inches.
Height " exclusive of steam chimney,	9 "	
Weight " without water, 65,200 pounds.		
Number of furnaces in each boiler, 3.		
Breadth of furnaces,	2 "	4½ "
	2 "	11 "
Length of grate bars,	6 "	
Number of flues, 15.		
Internal diameter of flues or tubes, 9 of		15½ "
2 "		14½ "
4 "		10 "
Length of flues, 5 of 15½ in.	15 "	3
the remainder,	10 "	
Heating surface, (fire and flues) in each boiler,	940 sq. feet.	
Diameter of smoke pipe,		50 inches.
Height, "	28 "	
Description of coal, Bituminous.		
Combustion, Natural draft.		
Consumption of coal per hour, 15 pounds.		

PADDLE WHEELS.—

Diameter,	22 feet.	
Length of blades,	8 "	
Depth, "		20 inches.
Number, " 20		

Remarks.—Floor timbers at throat, *moulded* 12 ins.; *sided*, 14 ins. Distance of frames apart *at centres*, 28 ins. Frame strapped with diagonal and double laid iron straps 4 by ½ ins. C. H. H.

*Castor Oil as a Mechanical Lubricant.** By ALEXANDER CHAPLIN.

In these times, when workshop economics are claiming so large a share of attention, it may be of importance to the readers of the *Practical Mechanics' Journal* to know that there is considerable advantage and economy in the use of pure castor oil as a lubricating material for machinery. For this purpose, I have found it to go at least twice as far as any other oil. The causes of this gain are, that this oil does not run out of the bearing, whilst it does not clog from viscidity, and it is entirely free from acidity of every kind. Actual experience has told me, that bearings which formerly required oiling twice or thrice a day, are kept in perfect order by one daily application of fine castor oil. As to cost, the present market price leaves, under the circumstances, a saving of 50 per cent.

Glasgow, September, 1855.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, December 20, 1855.

John Agnew, Vice President, in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

A letter was read from the Royal Imperial Geological Society of Vienna, Austria.

Donations to the Library were received from The Commissioners of Patents, Great Seal Patent Office; The Royal Astronomical Society; The Institute of Actuaries, and the Society of Arts, &c., London; The Royal Imperial Geological Society of Vienna, Austria; Lieut. J. M. Gillis, U. S. Navy; The University of Michigan, The Baltimore and Ohio Railroad Co., The West Jersey Collegiate School, and from Prof. J. F. Frazer, Mrs. W. H. Keating, Dr. J. A. Meigs, Philip Price, and George M. Conarroe, Philadelphia.

Donations to the Cabinets of Models and of Minerals from Josephus Echols, Columbus, Georgia; and Dr. L. Turnbull, Dr. J. T. Sharpless, Wm. H. Dennison, and E. G. Pomeroy of Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of November.

The Board of Managers and Standing Committees reported their minutes.

Resignations of membership in the Institute by 12 gentlemen, were read and accepted.

The candidates for membership in the Institute, (17,) were proposed, and the candidates proposed at the last meeting, (11,) were duly elected.

The Corresponding Secretary was instructed to send to the Commissioners of Patents, Great Seal Patent Office, London, a special acknowledgment of the valuable donation received from them.

Nominations were made for officers, managers, and auditors of the Institute for the ensuing year.